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ROYAL AIRCRAFT ESTABLISHMENT FARNBOROUGH (ENGLAND)
CONTRIBUTIONS TO THE UK MICROWAVE LANDING SYSTEM RESEARCH AND D--ETC(U)
MAY 79 J M JONES
RAE-TR-79052-VOL-2

F/6 17/7

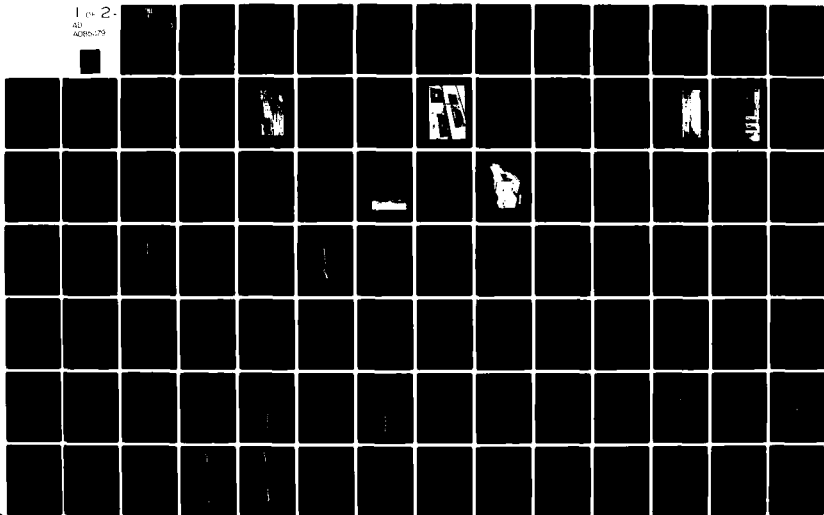
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1 of 2

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✓ ROYAL AIRCRAFT ESTABLISHMENT

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9 Technical Report 79052

11 May 1979

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BR73762

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JUN 13 1980

6 CONTRIBUTIONS TO THE UK MICROWAVE
LANDING SYSTEM RESEARCH AND
DEVELOPMENT PROGRAMME 1974 TO 1978.

Volume 2.

by

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VOLUME 2

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14 RAE-TR-79052-VOL-2

Procurement Executive, Ministry of Defence
Farnborough, Hants

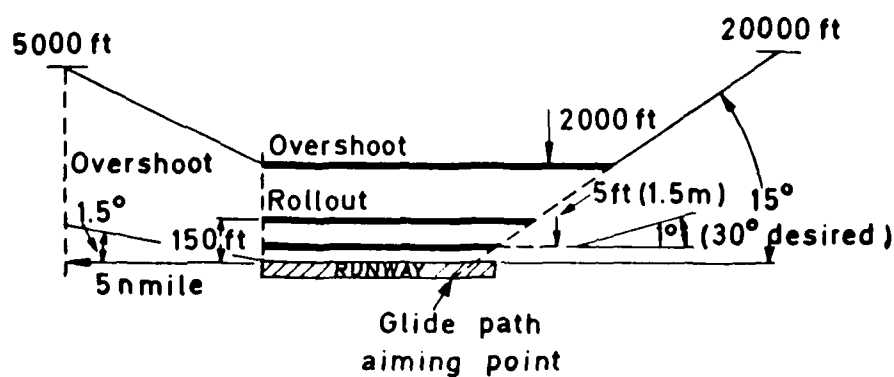
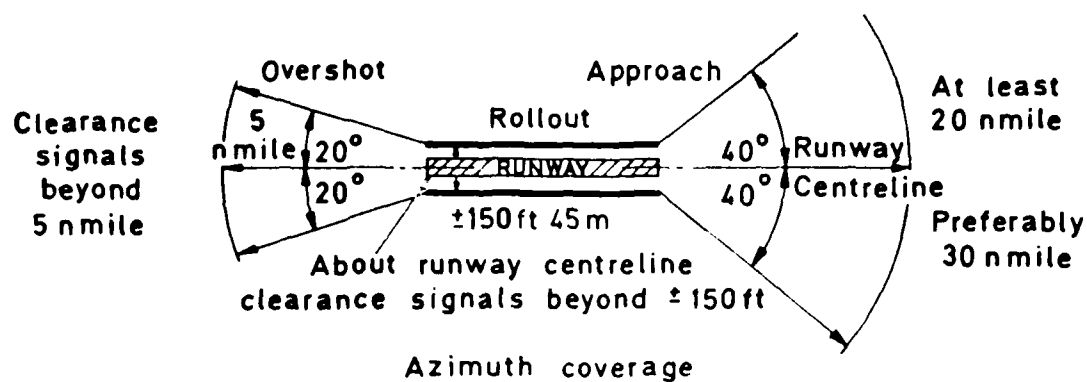
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Fig 1.1



Vertical coverage

Fig 1.1 Coverage requirements for MLS

Fig 2.1

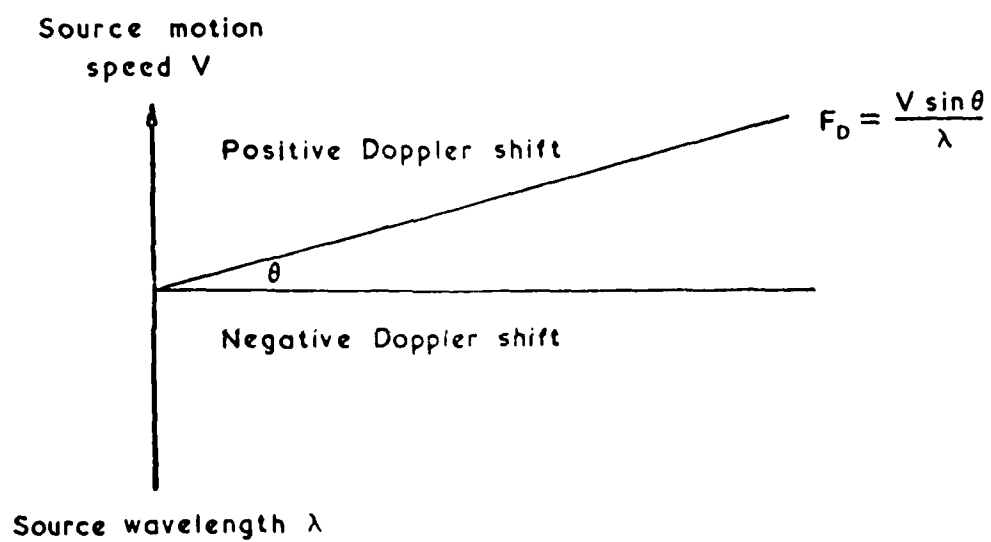


Fig 2.1 Doppler effect

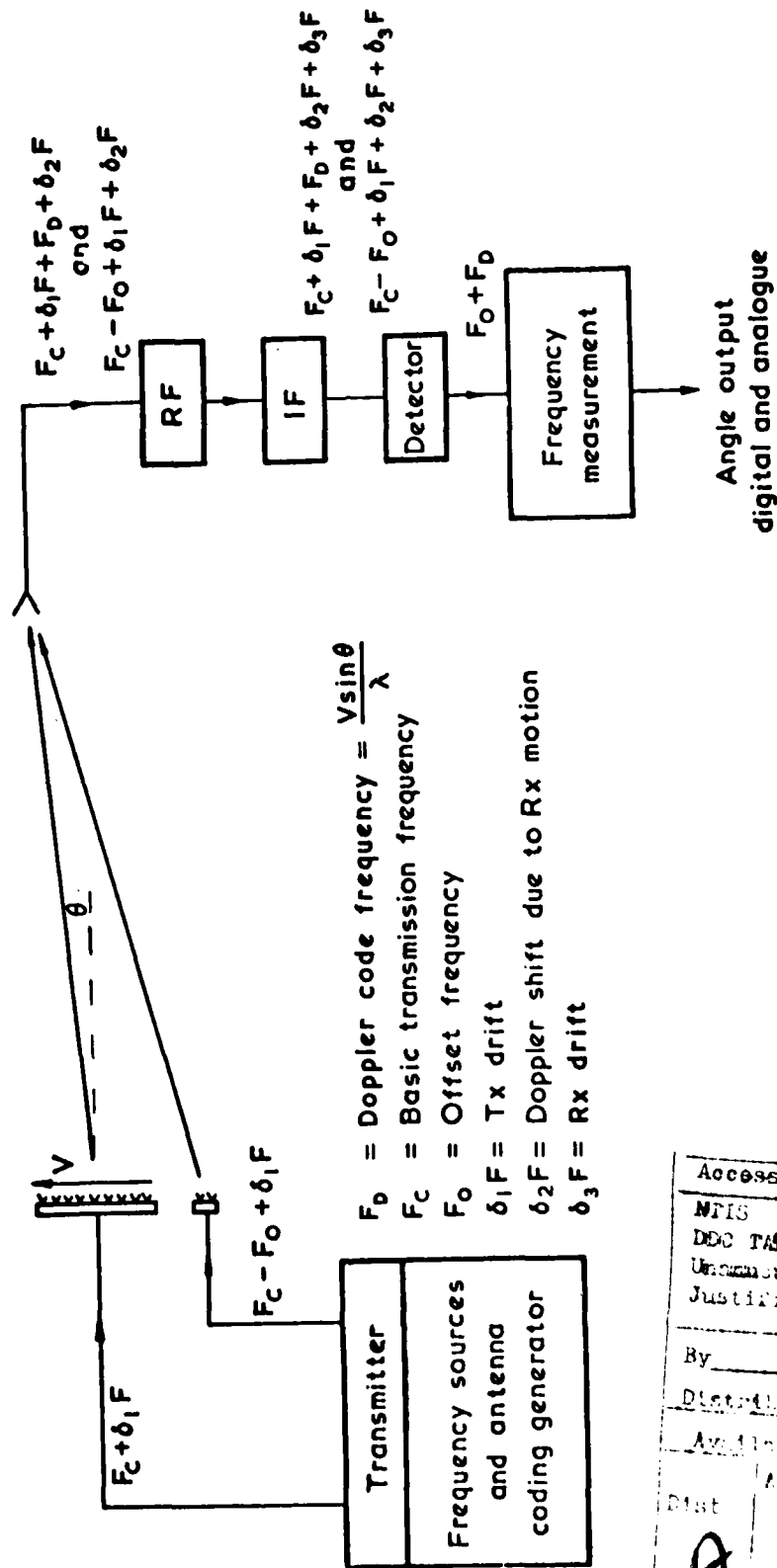
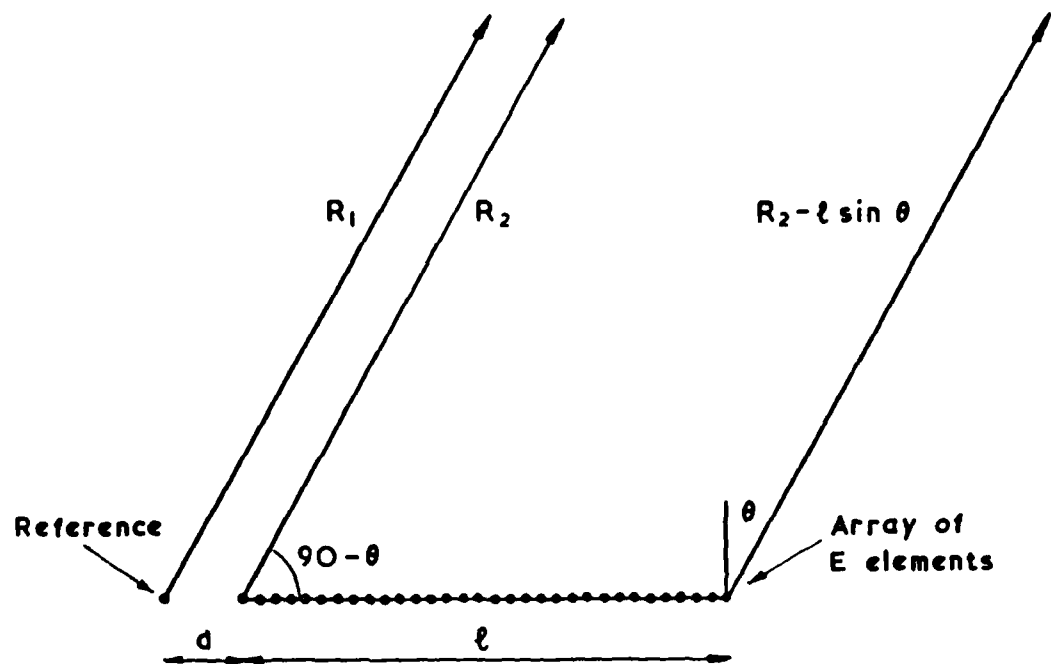


Fig 2.2

Fig 2.2 Basic system - block diagram

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Justification	<input type="checkbox"/>
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Distribution	
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Fig 2.3



$$d = D\lambda \quad \ell = L\lambda$$

Reference transmission $\exp j\omega_R t$

Array signal 'left to right' $\exp j(\omega_{A_1} t + \alpha)$

Array signal 'right to left' $\exp j(\omega_{A_2} t + \beta)$

Fig 2.3 Propagation geometry

Fig 2.4

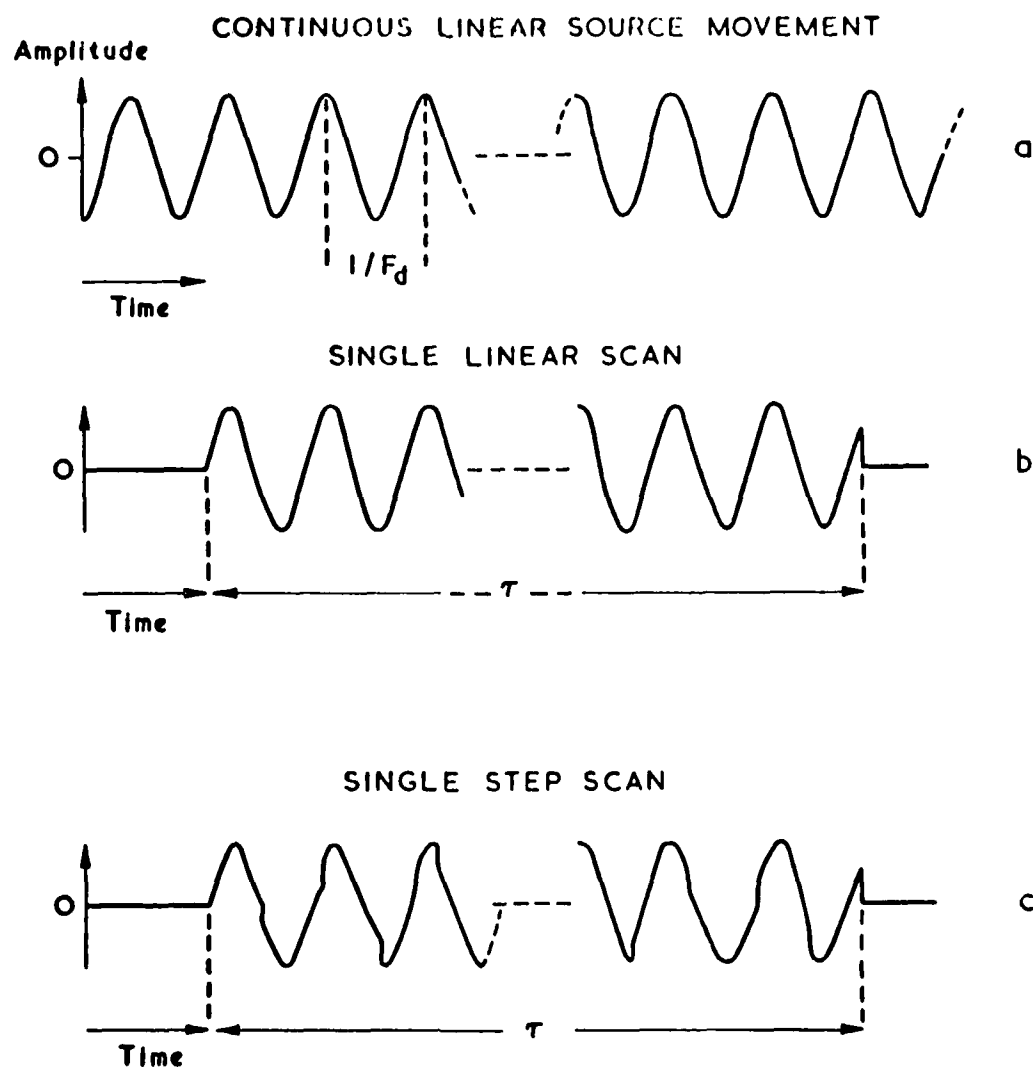


Fig 2.4 Doppler signal waveforms

Fig 2.5

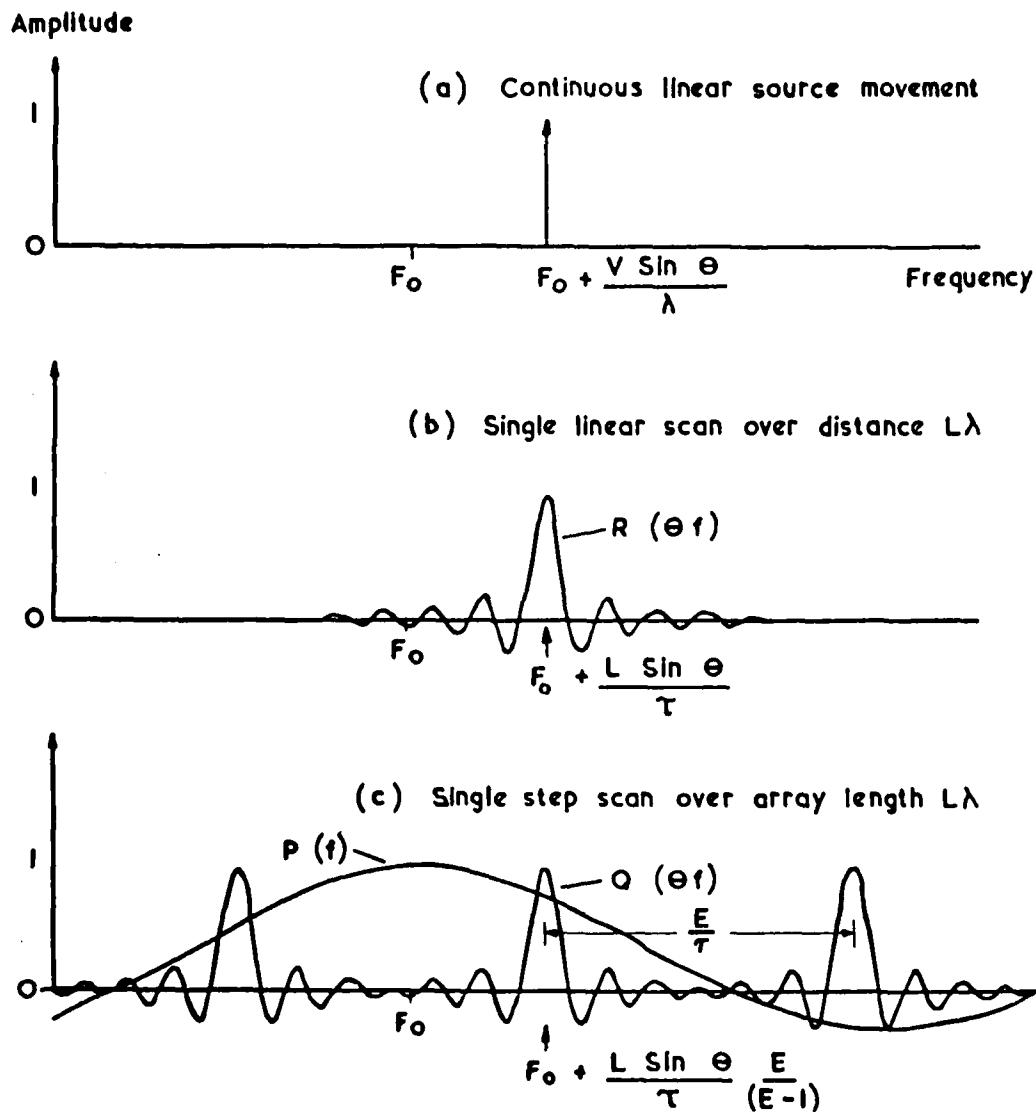


Fig 2.5 Doppler signal spectra

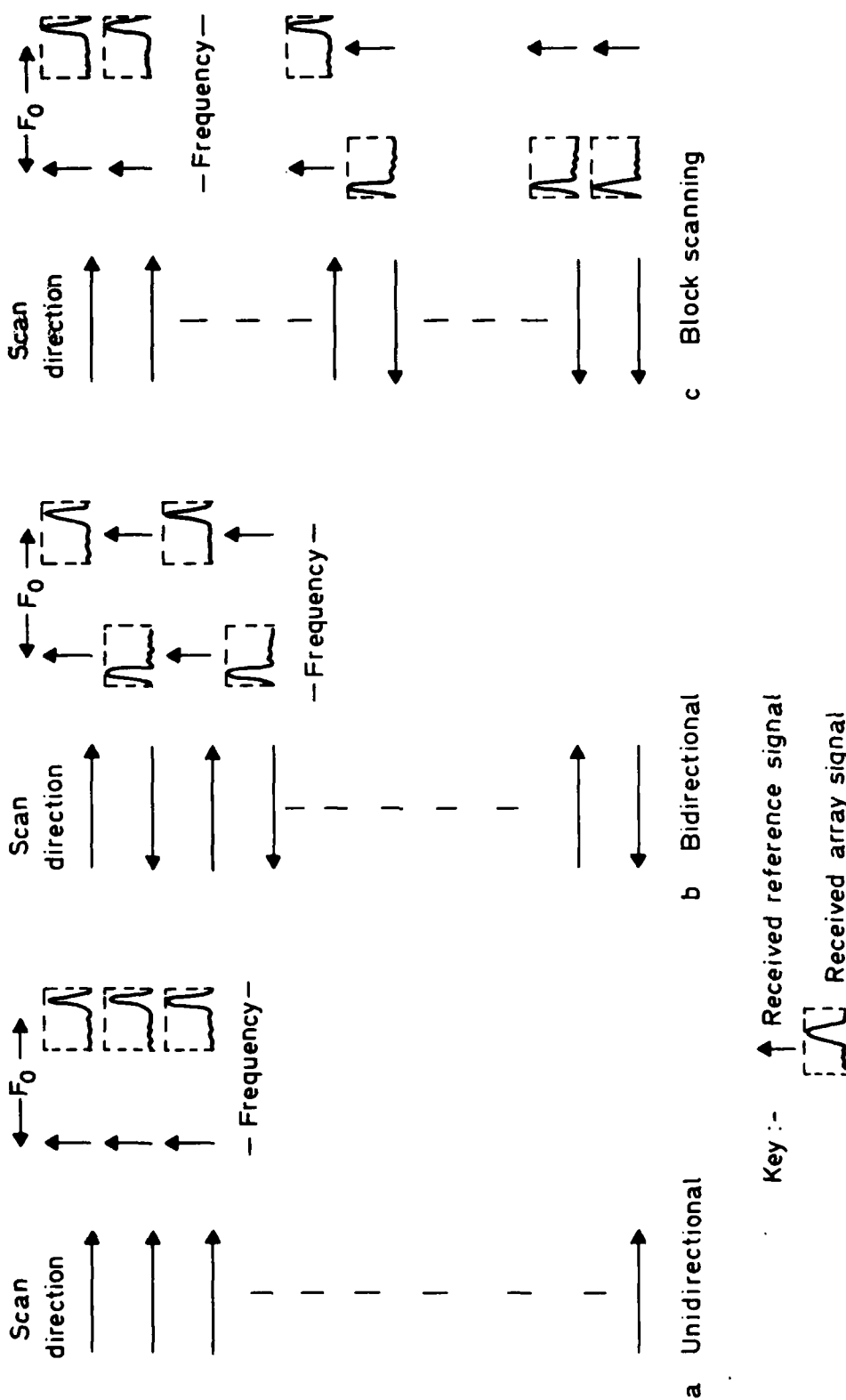


Fig 2.6

Fig 2.6 Typical angle transmission formats

Fig 2.7

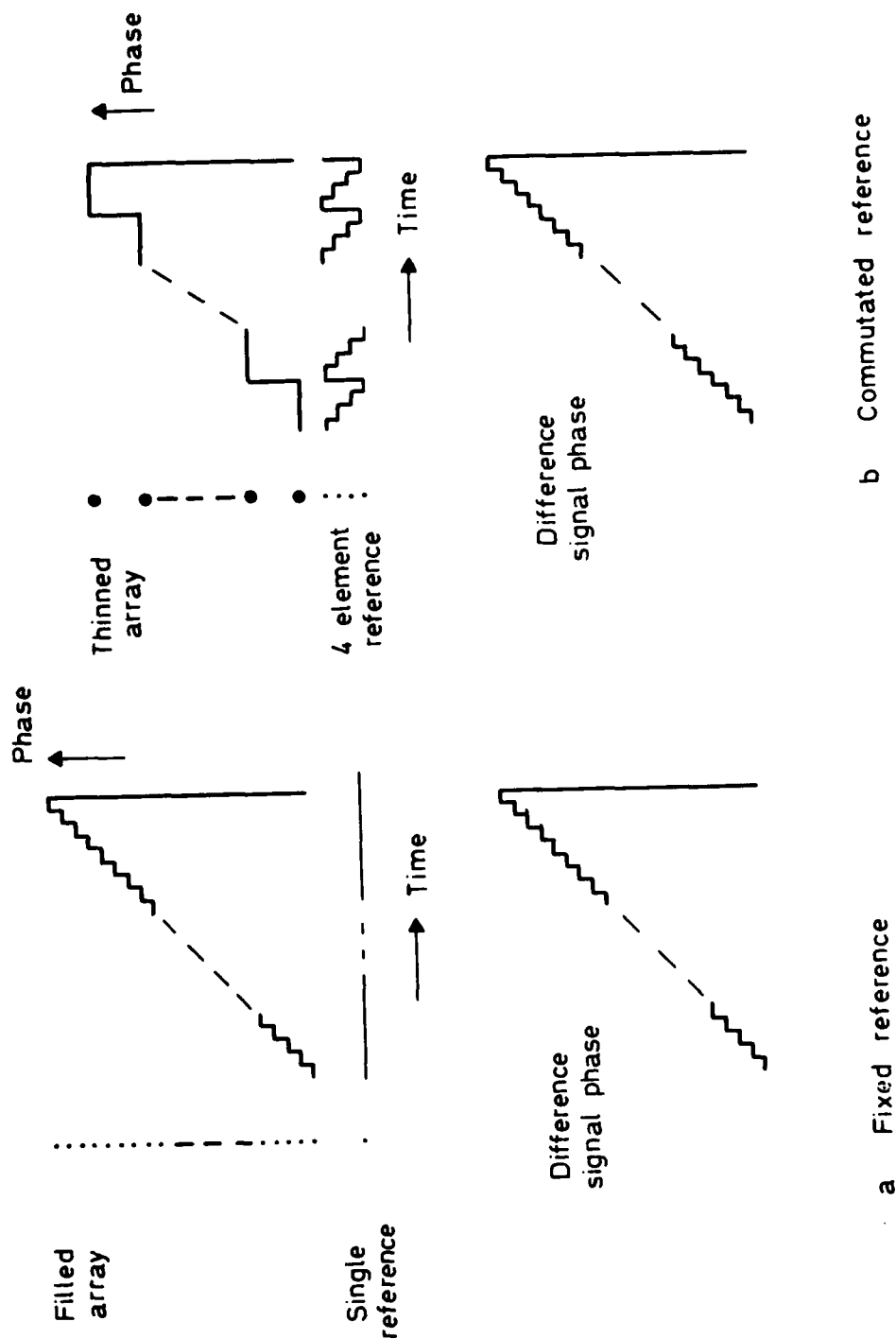


Fig 2.7 Fixed and commutated reference systems

Fig 2.8

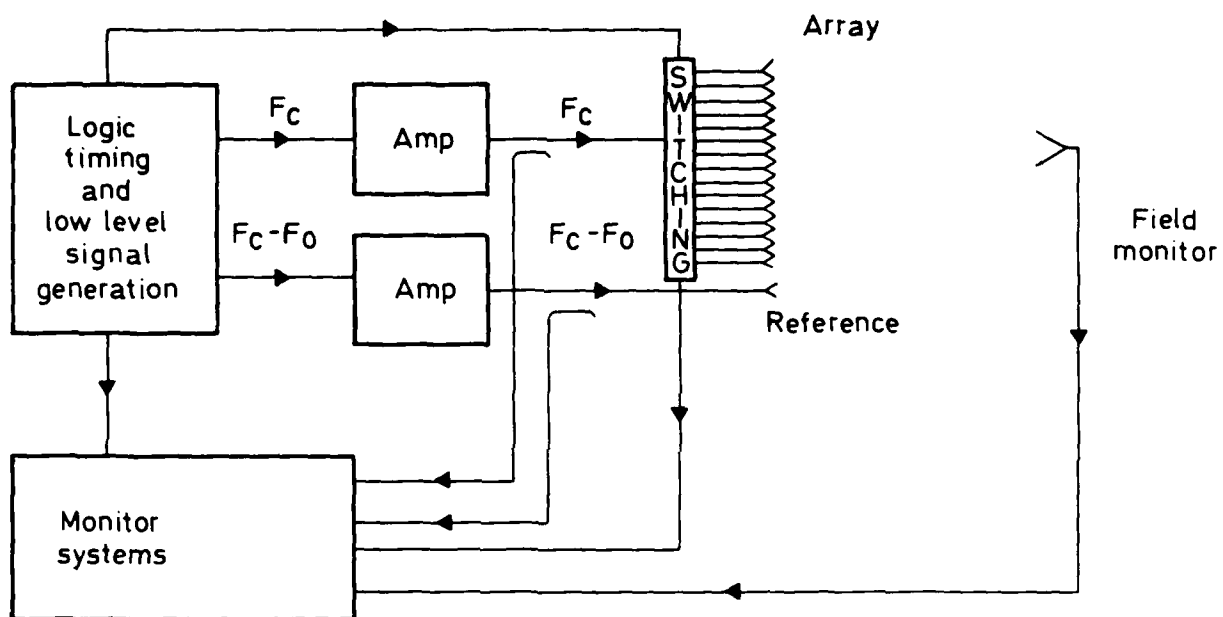
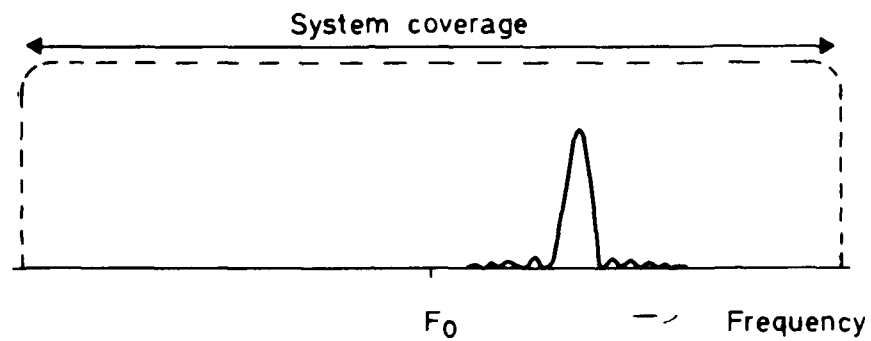
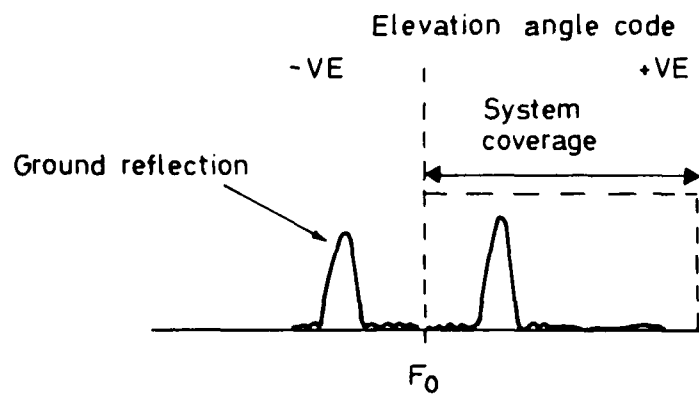


Fig 2.8 The basic DMLS ground system

Fig 2.9a&b



2.9a Azimuth system



2.9b Elevation system

Fig 2.9a&b Received difference signal spectra

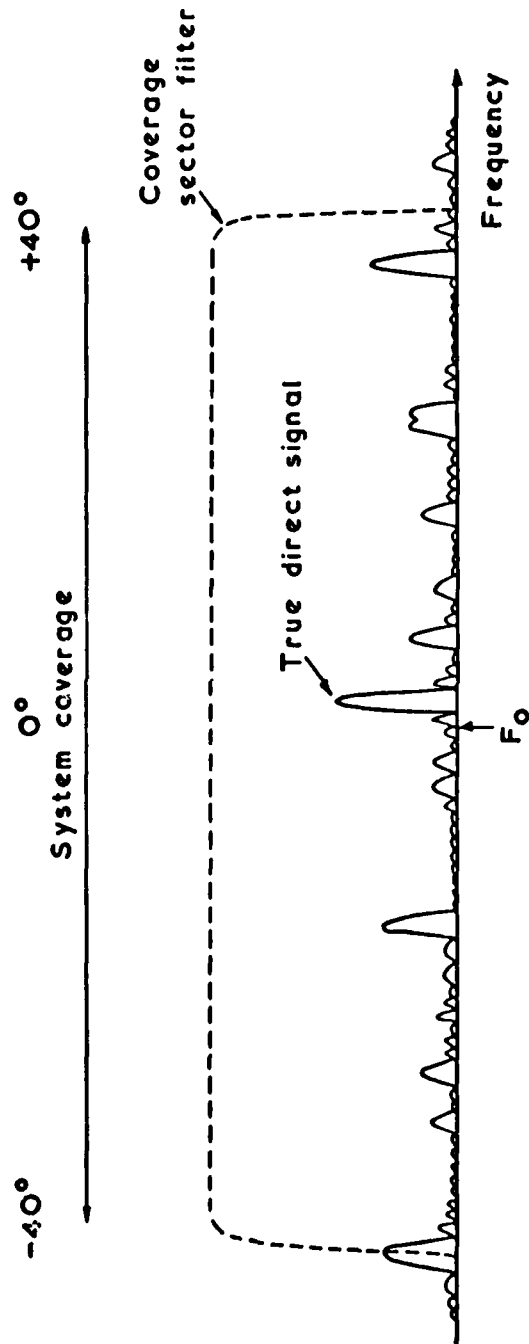


Fig 2.10 Doppler signal with multipath

Fig 2.11

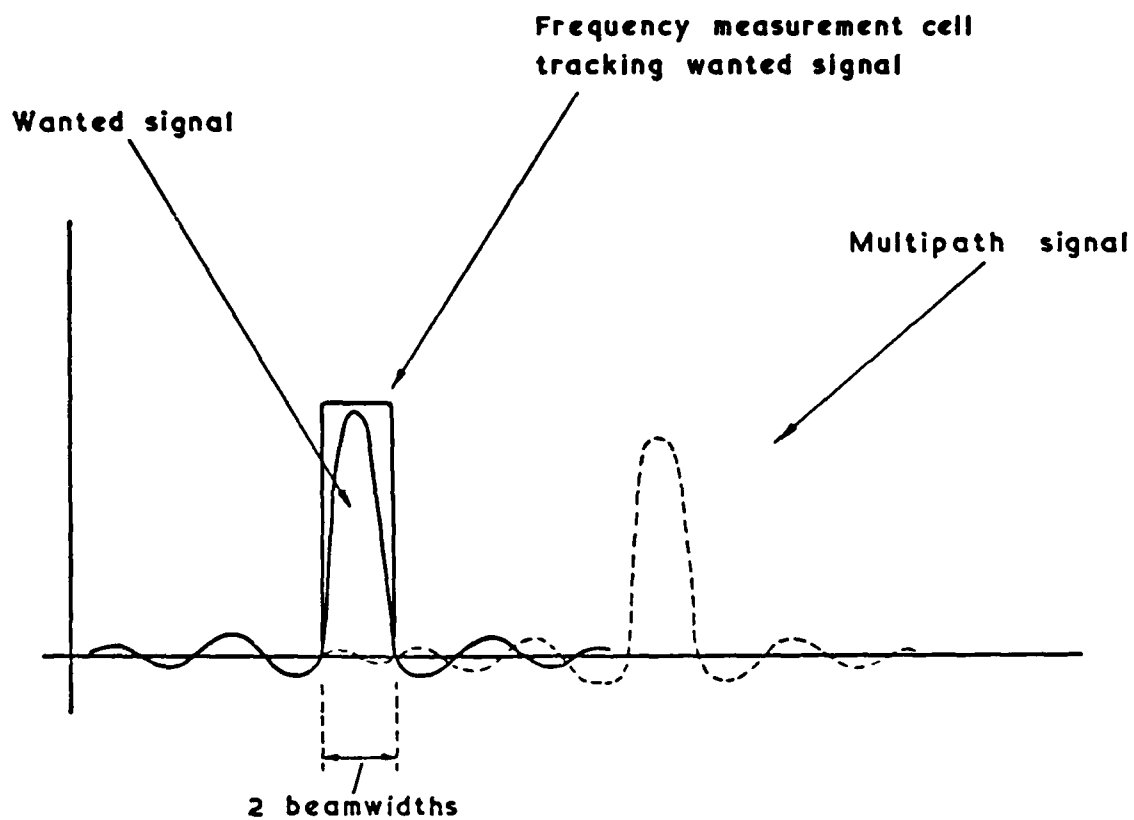
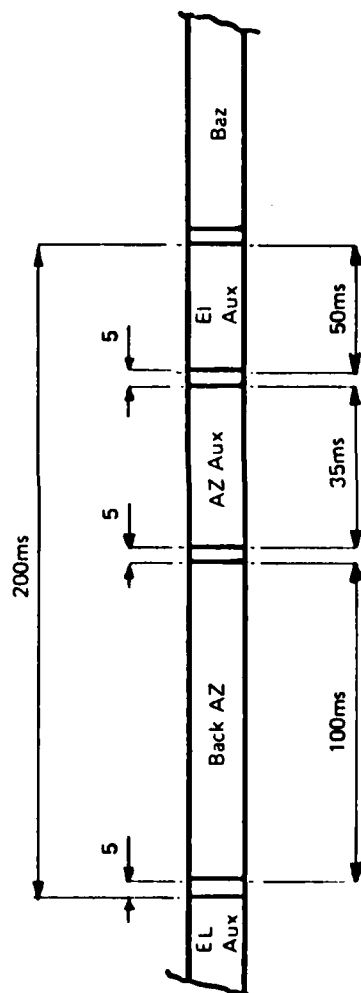


Fig 2.11 Separation of wanted signal using frequency cell



Time plane for TDM facility

Fig 3.1 Hybrid format

Fig 3.2

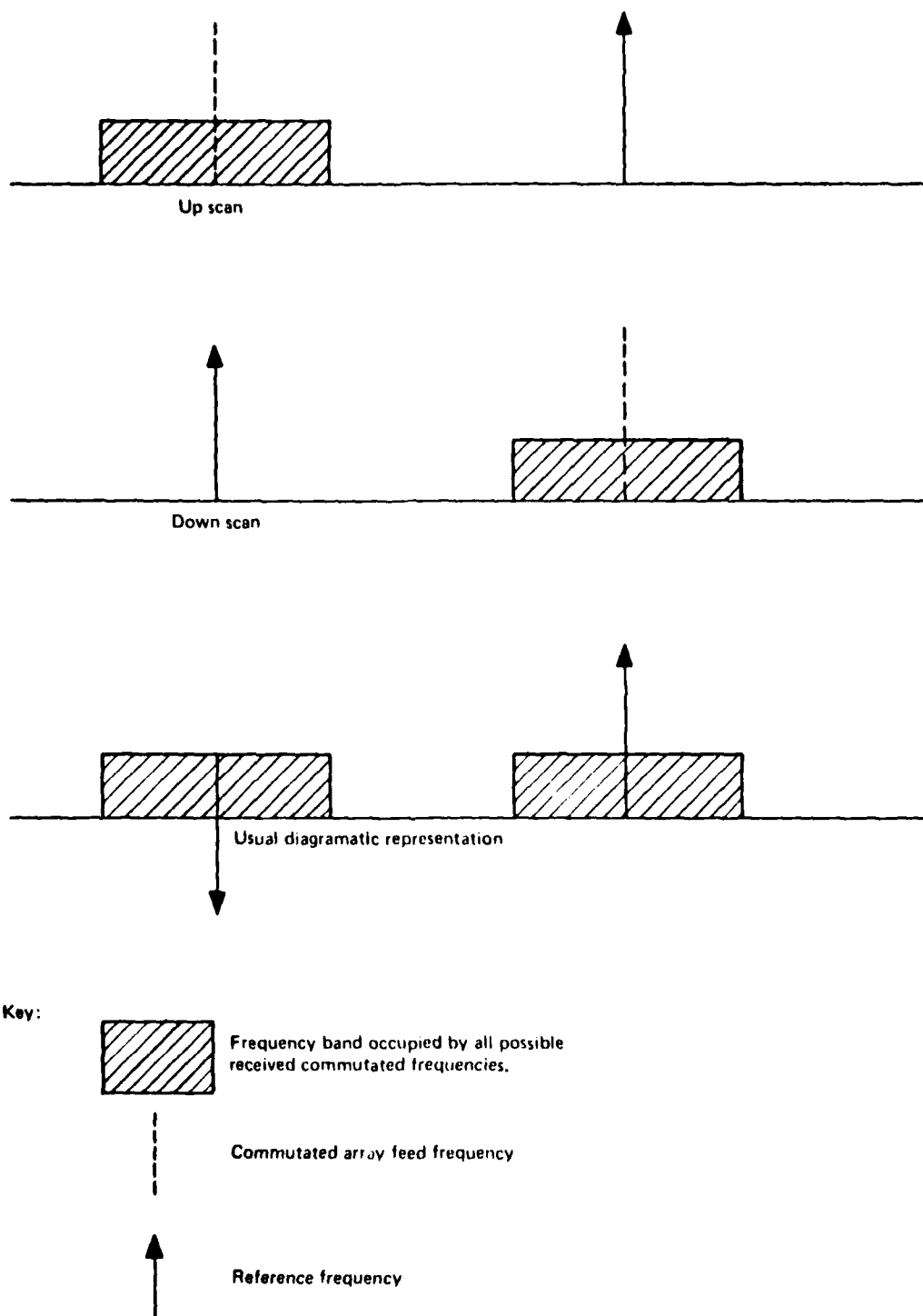


Fig 3.2 Frequency interchange method of providing offset frequency

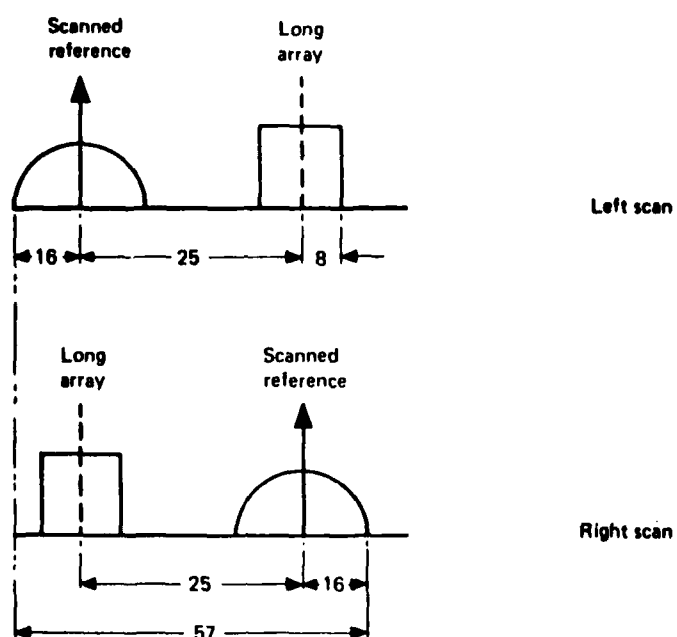


Fig 3.3 Azimuth sub-channel frequencies (kHz)

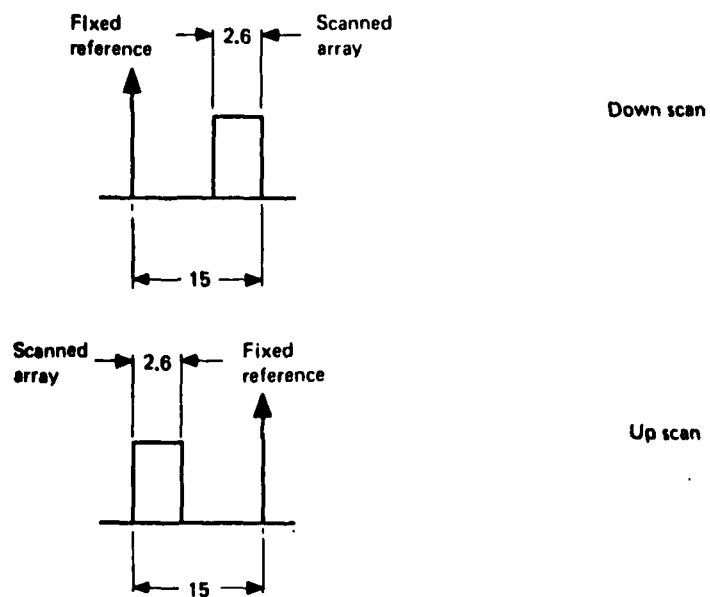


Fig 3.4 Elevation sub-channel frequencies (kHz)

Fig 3.5



Fig 3.5 120 wavelength azimuth antenna

Fig 3.6

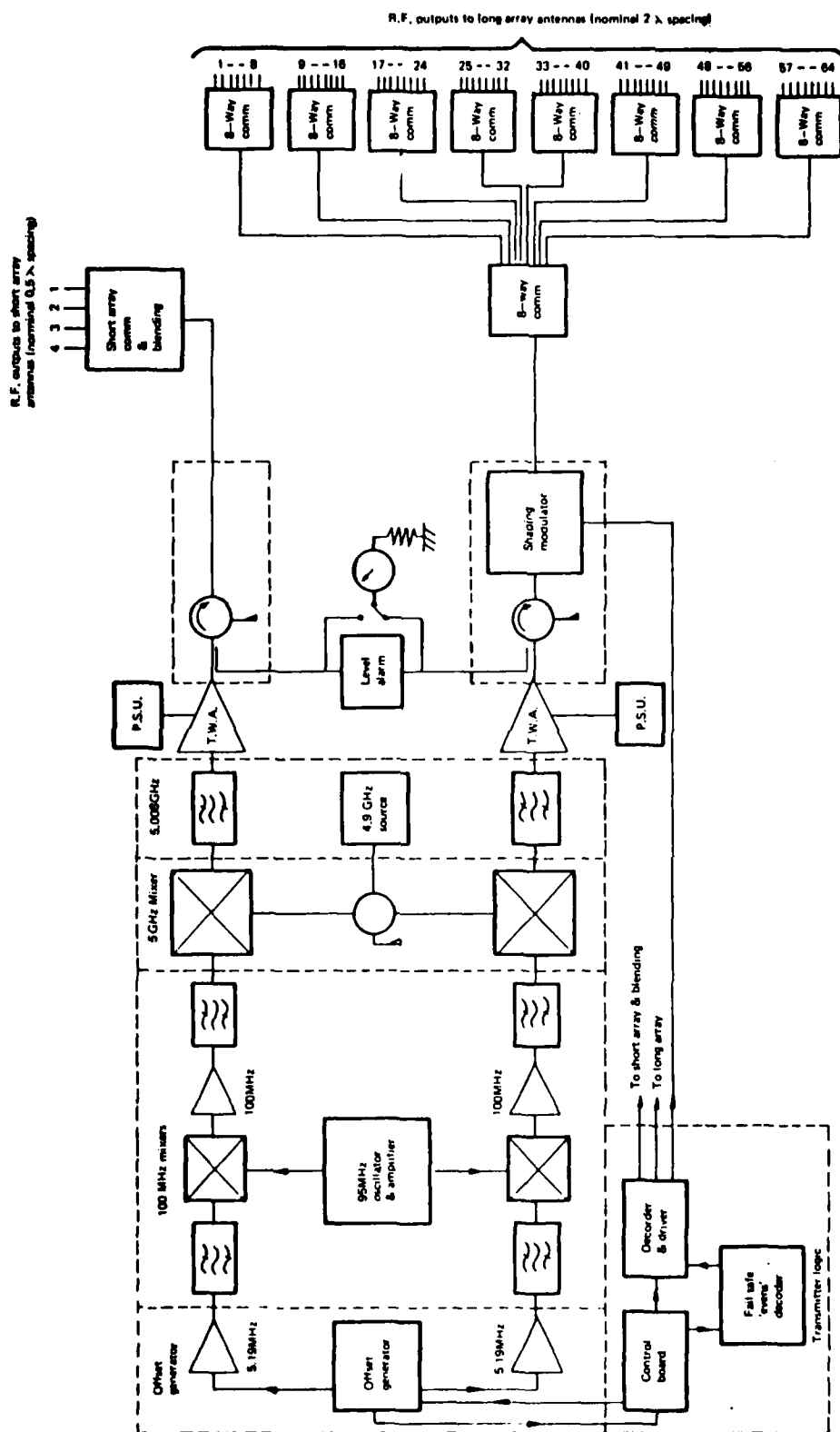


Fig 3.6 Azimuth transmitter block diagram

Fig 3.7

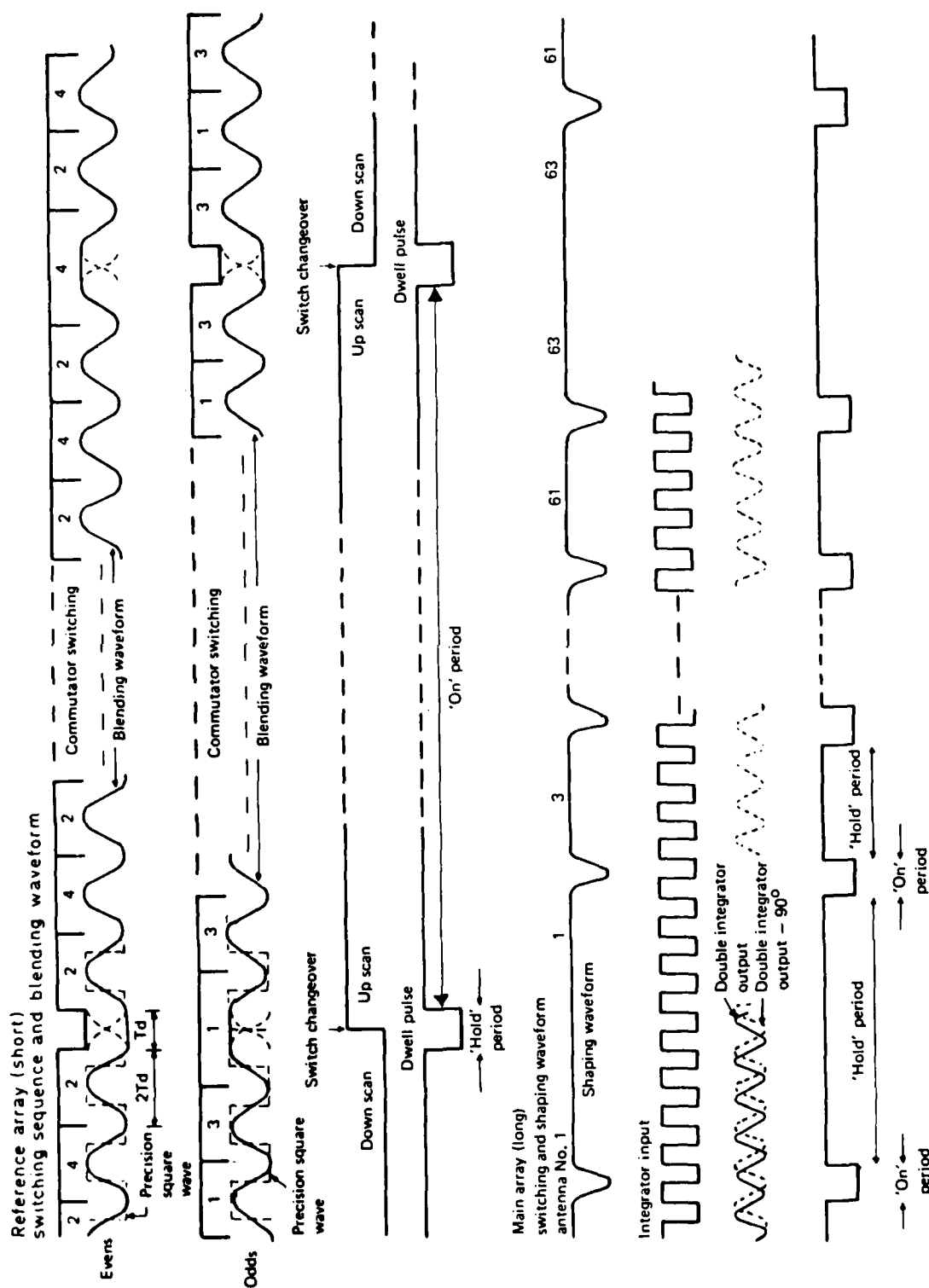


Fig 3.7 Azimuth facilities blending and shaping

Fig 3.8

TR 79052 C15526

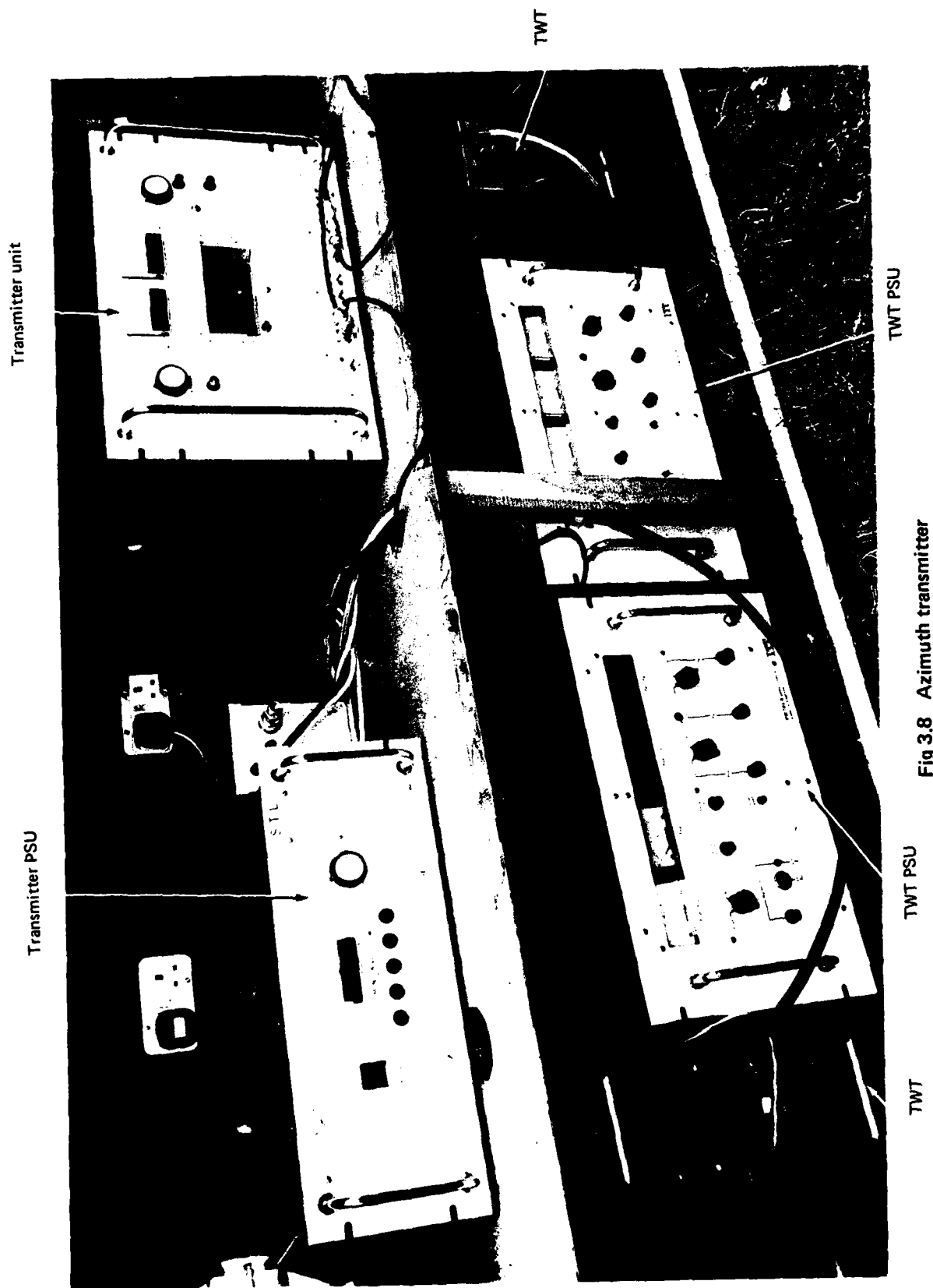


Fig 3.8 Azimuth transmitter

Fig 3.9

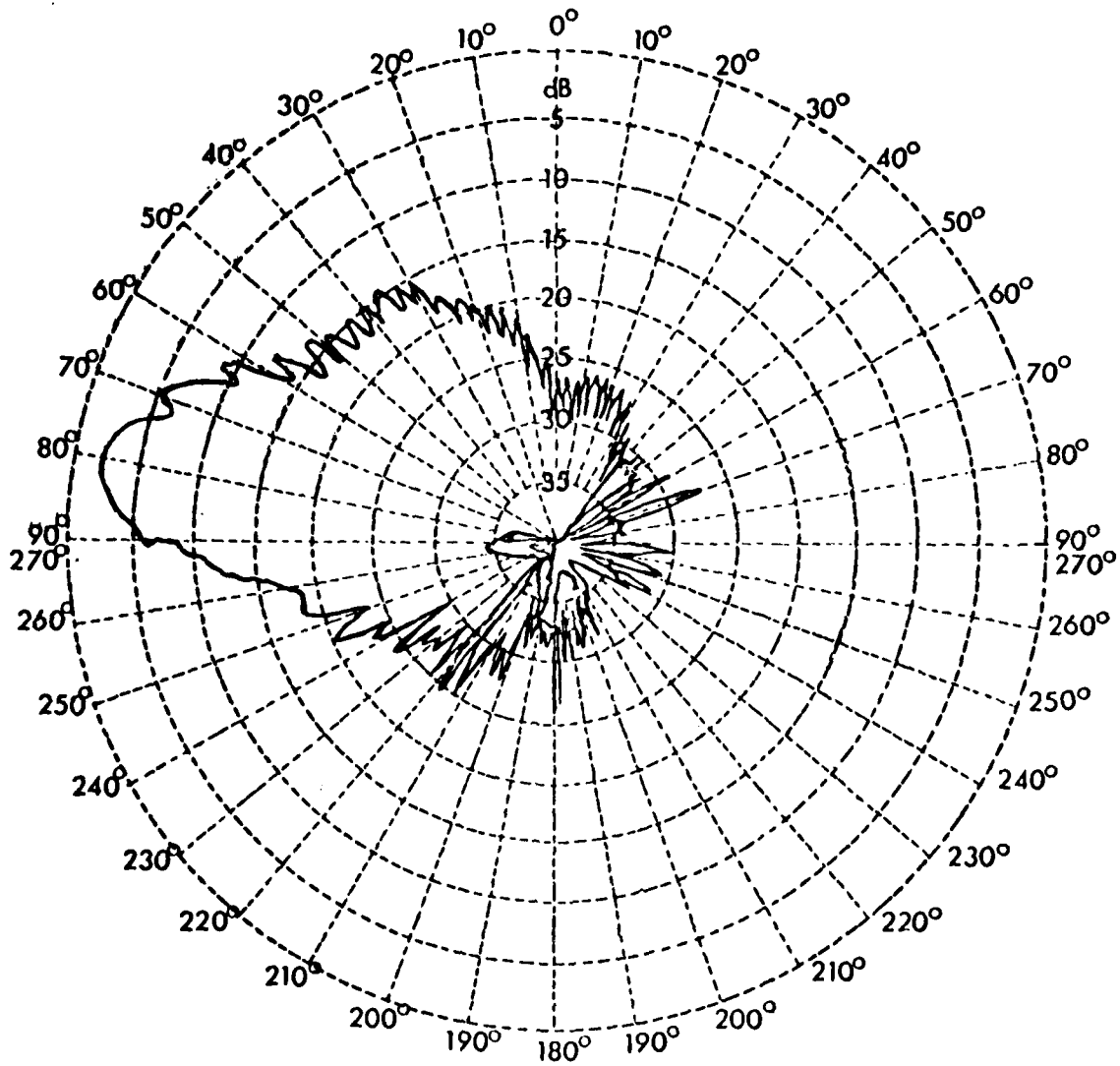


Fig 3.9 Monopole on 3 ft counterpoise (vertical pattern)

Fig 3.10

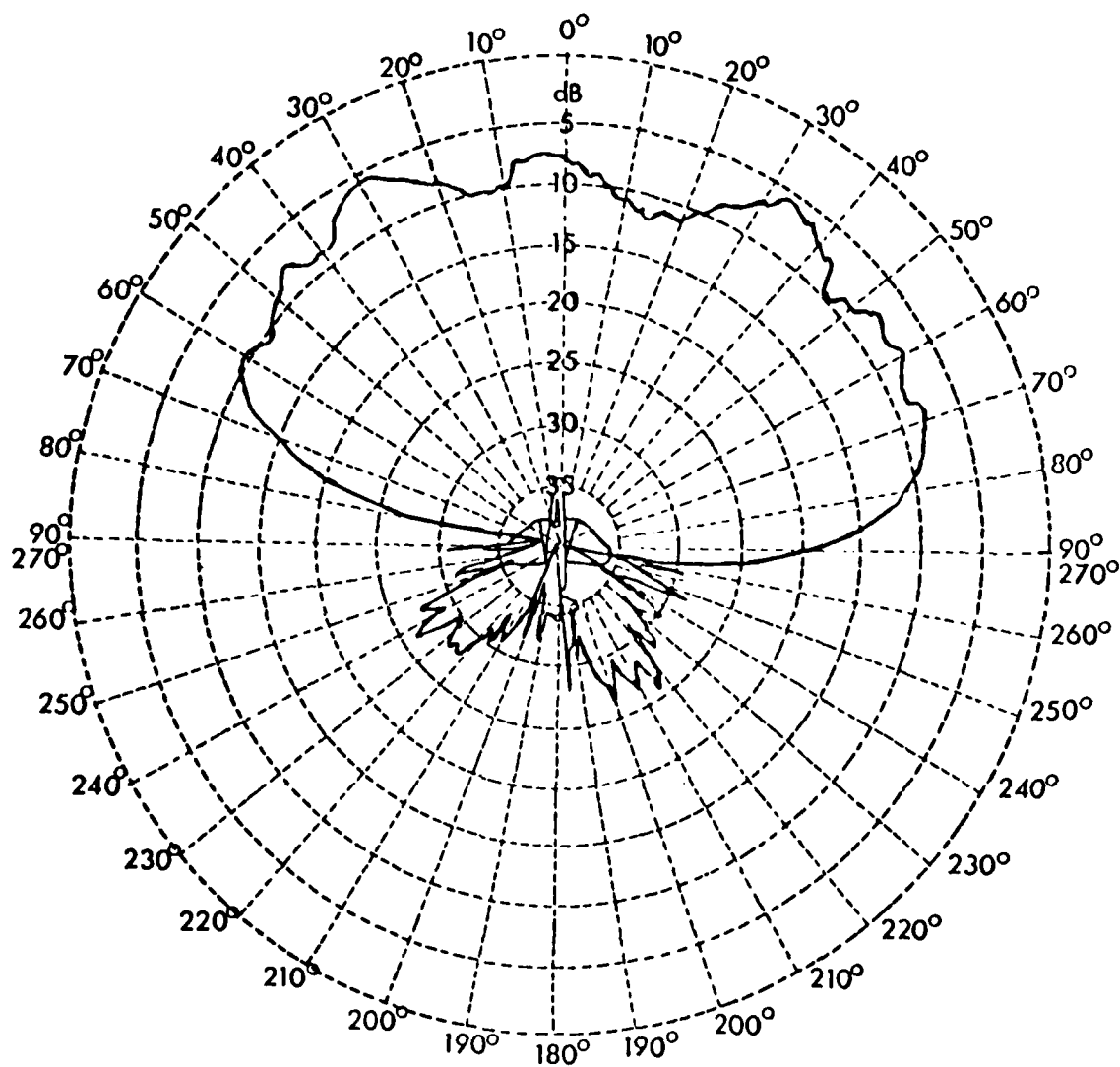


Fig 3.10 Monopole on 3 ft counterpoise (horizontal pattern)

Fig 3.11

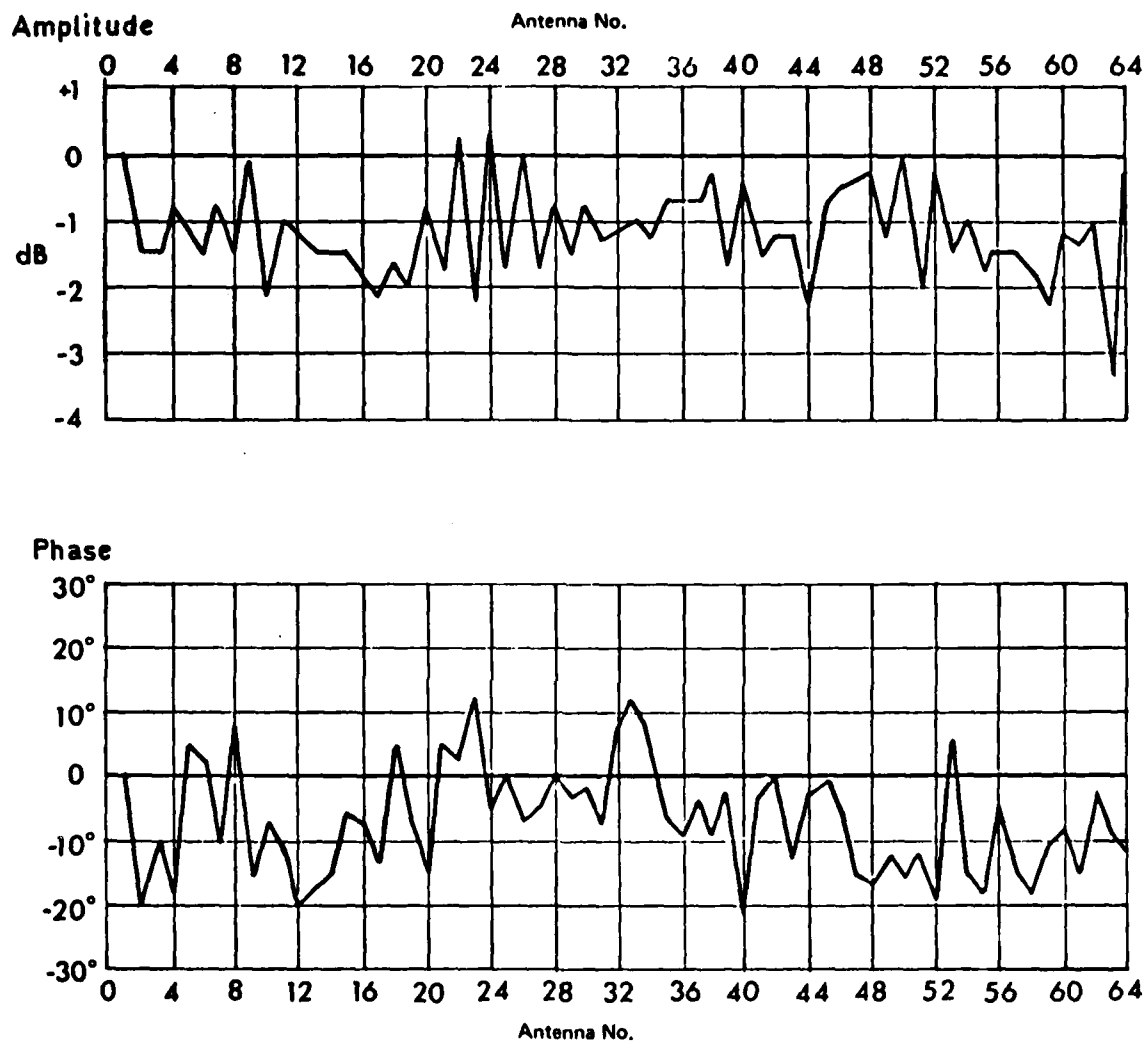


Fig 3.11 Transmitted signal phase and amplitude spread (approach azimuth)

TR 79082 C18827



Fig 3.12 Missed approach azimuth

Fig 3.13

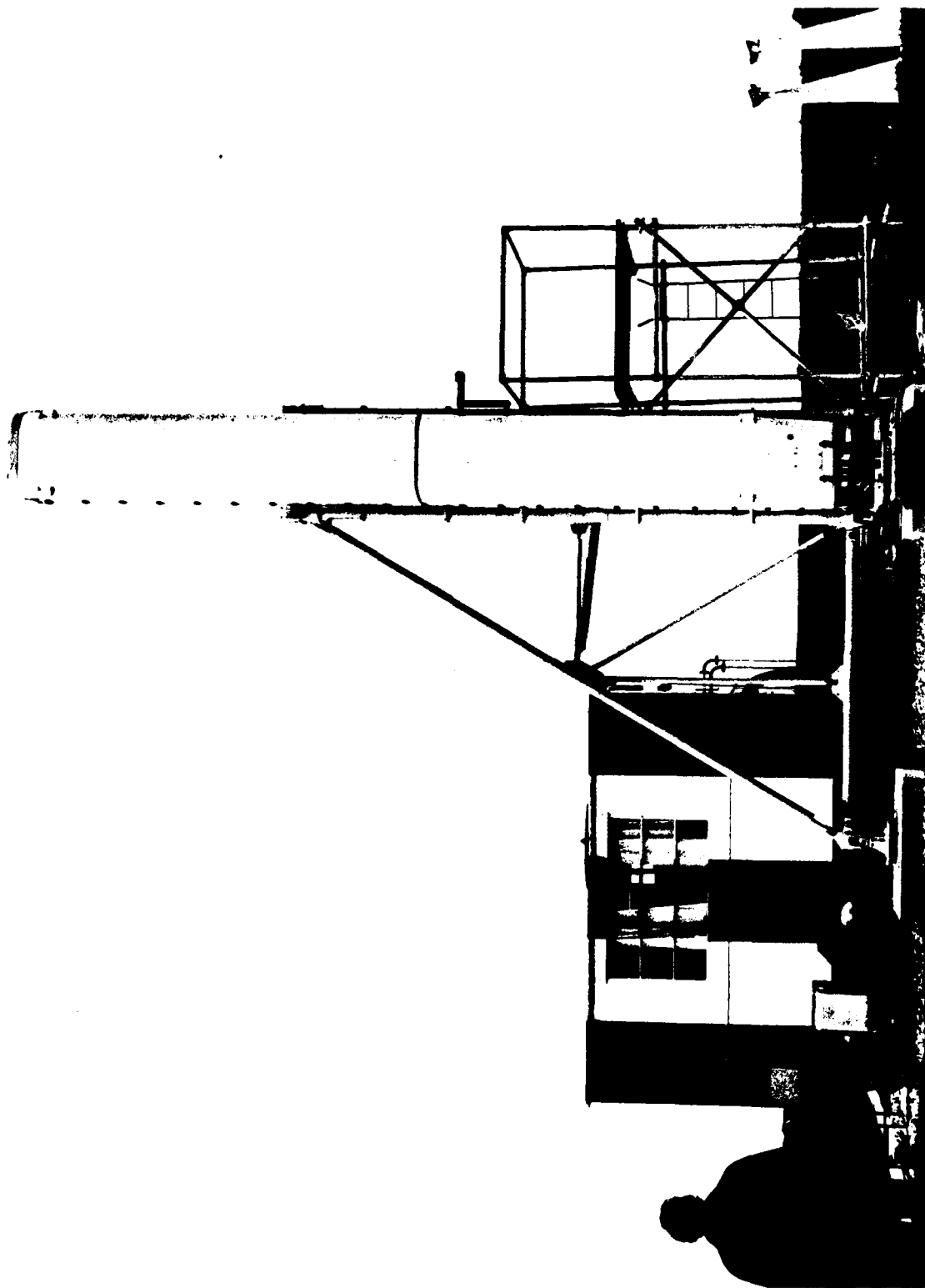


Fig 3.13 90 wavelength elevation array

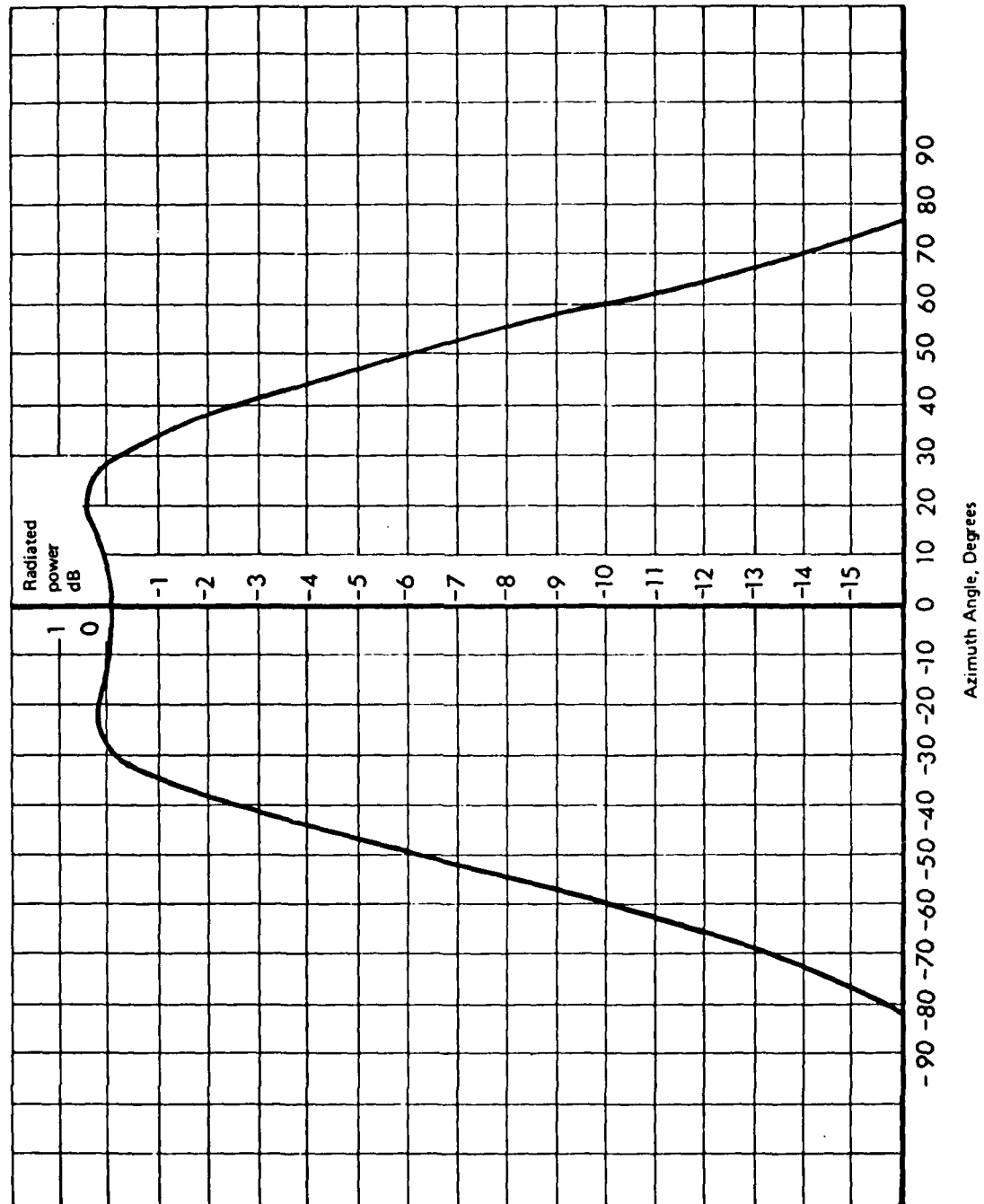


Fig 3.14 Array element azimuth radiation pattern

Fig 3.15

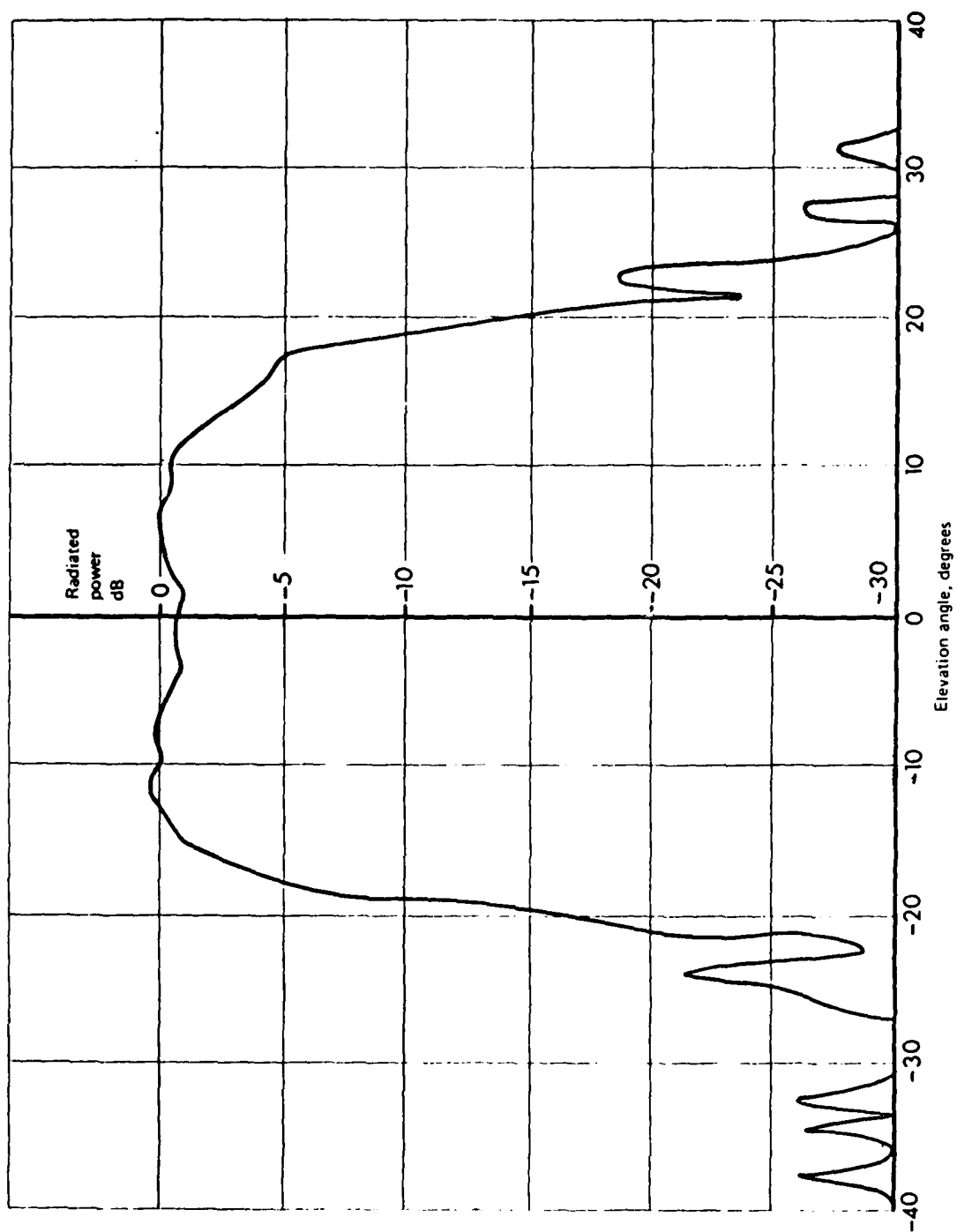


Fig 3.15 Array element elevation radiation pattern

Fig 3.16

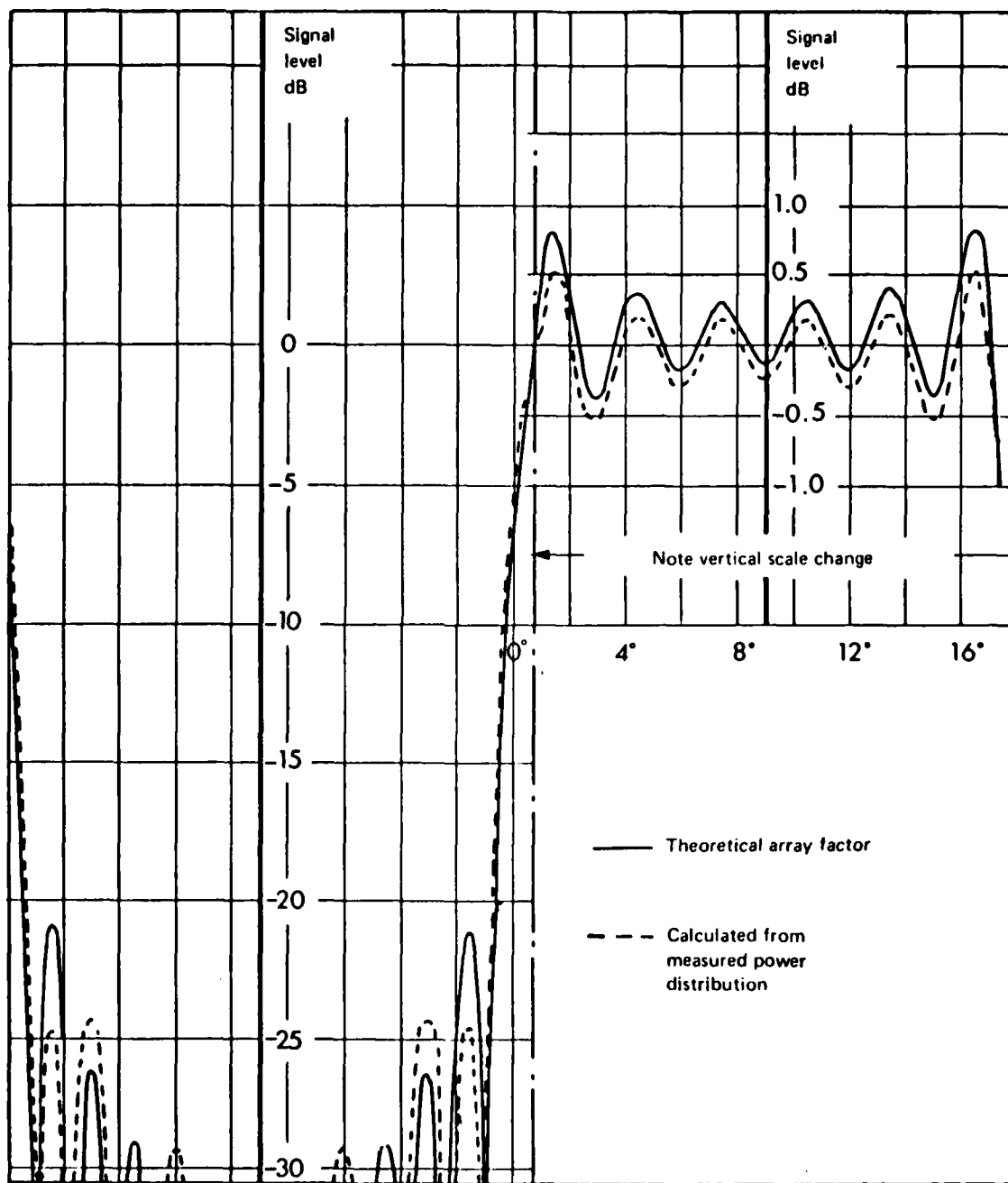


Fig 3.16 Reference antenna array factors

Fig 3.17

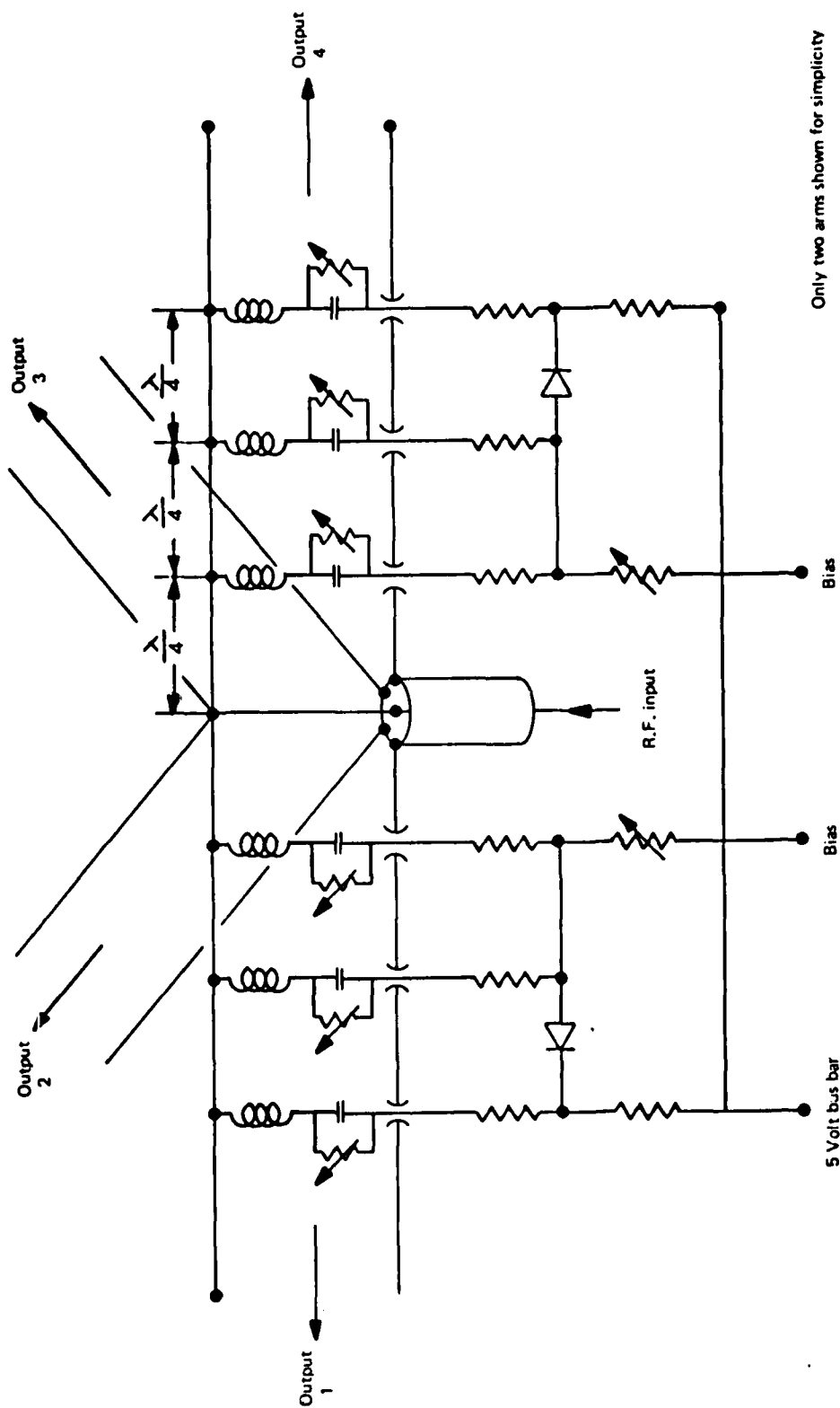


Fig 3.17 Resonant switch and biasing circuit

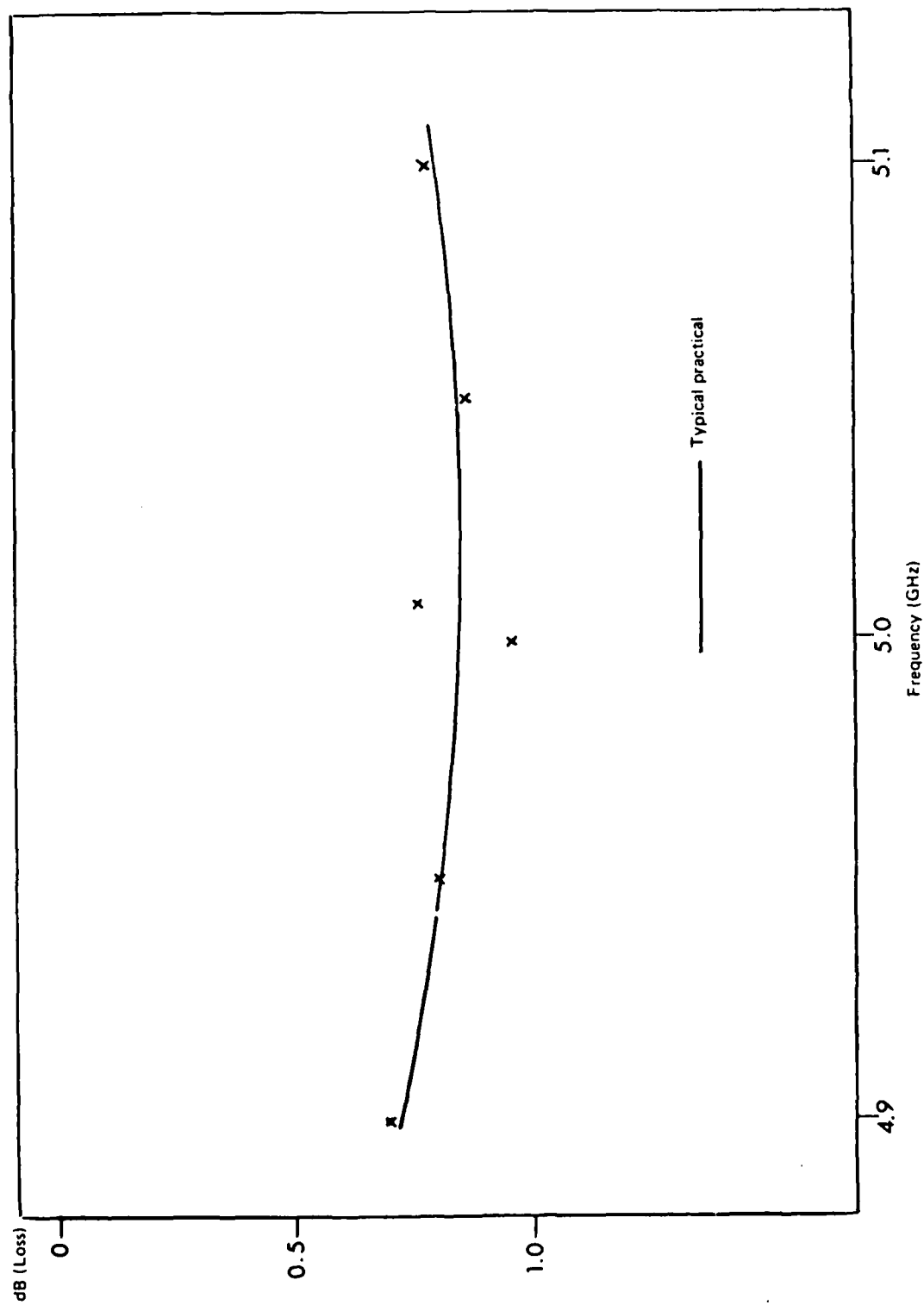


Fig 3.18

Fig 3.18 Curve of insertion loss for 4-way switching module

Fig 3.19

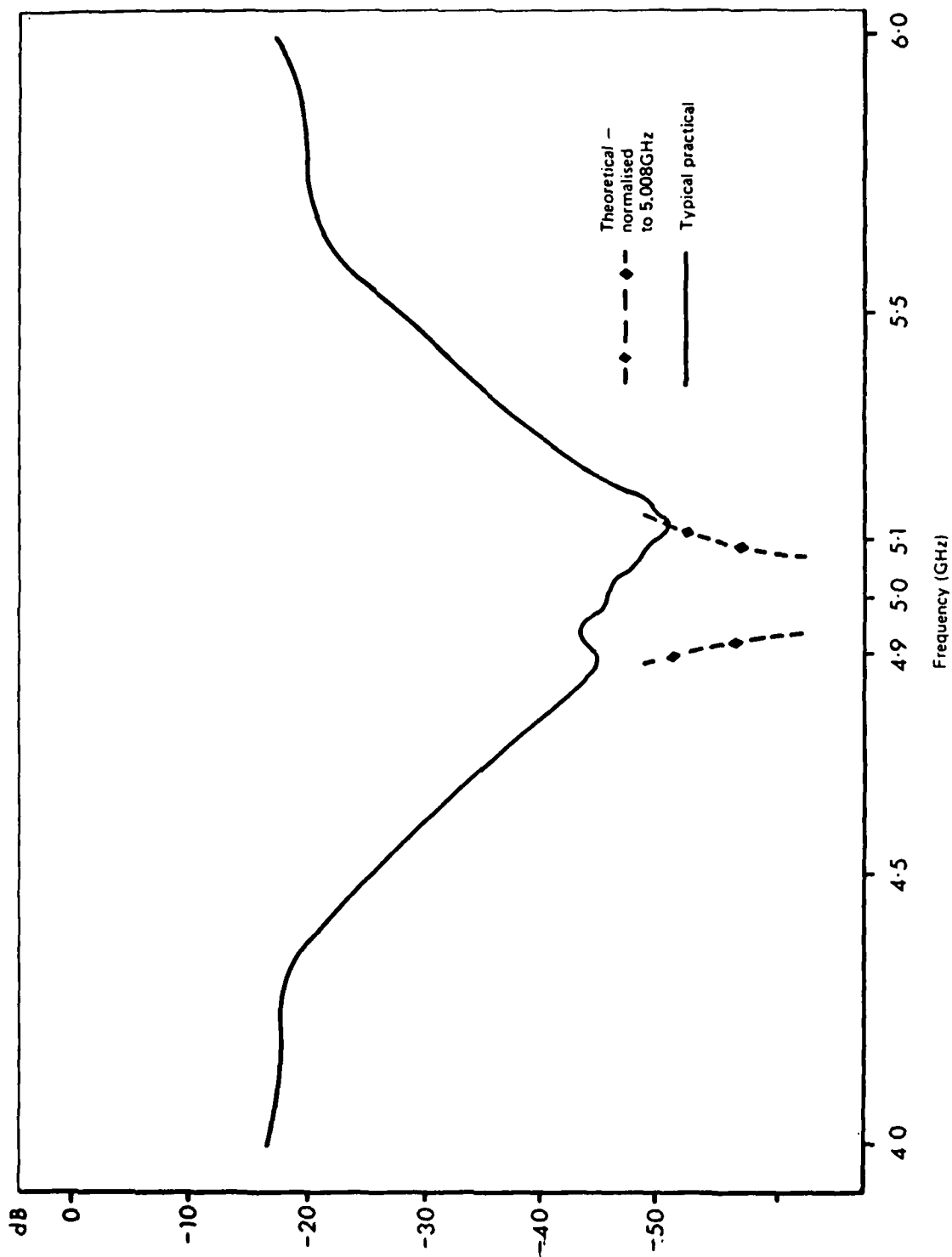


Fig 3.19 Theoretical and practical curves of isolation for 4-way switching module

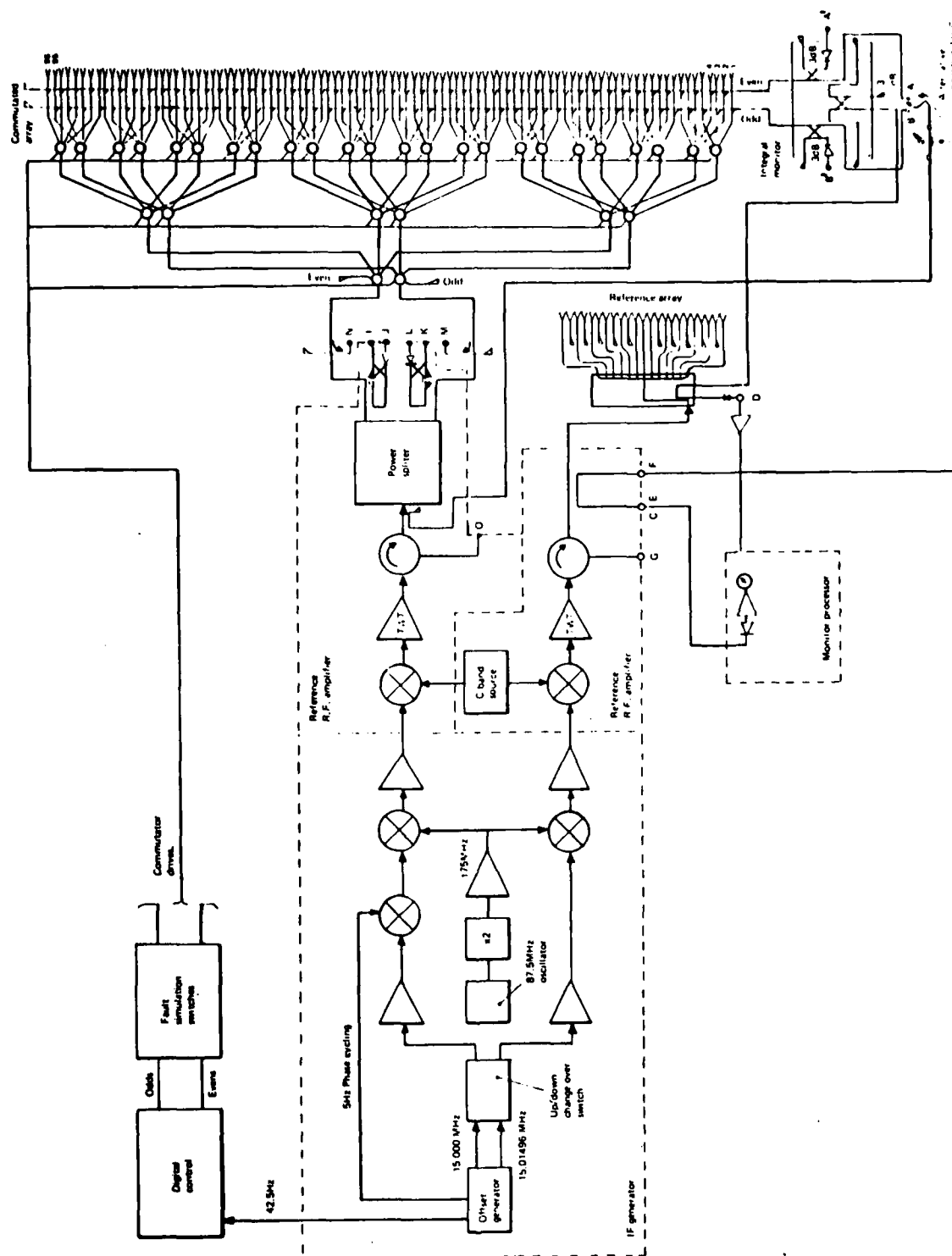


Fig 3.21

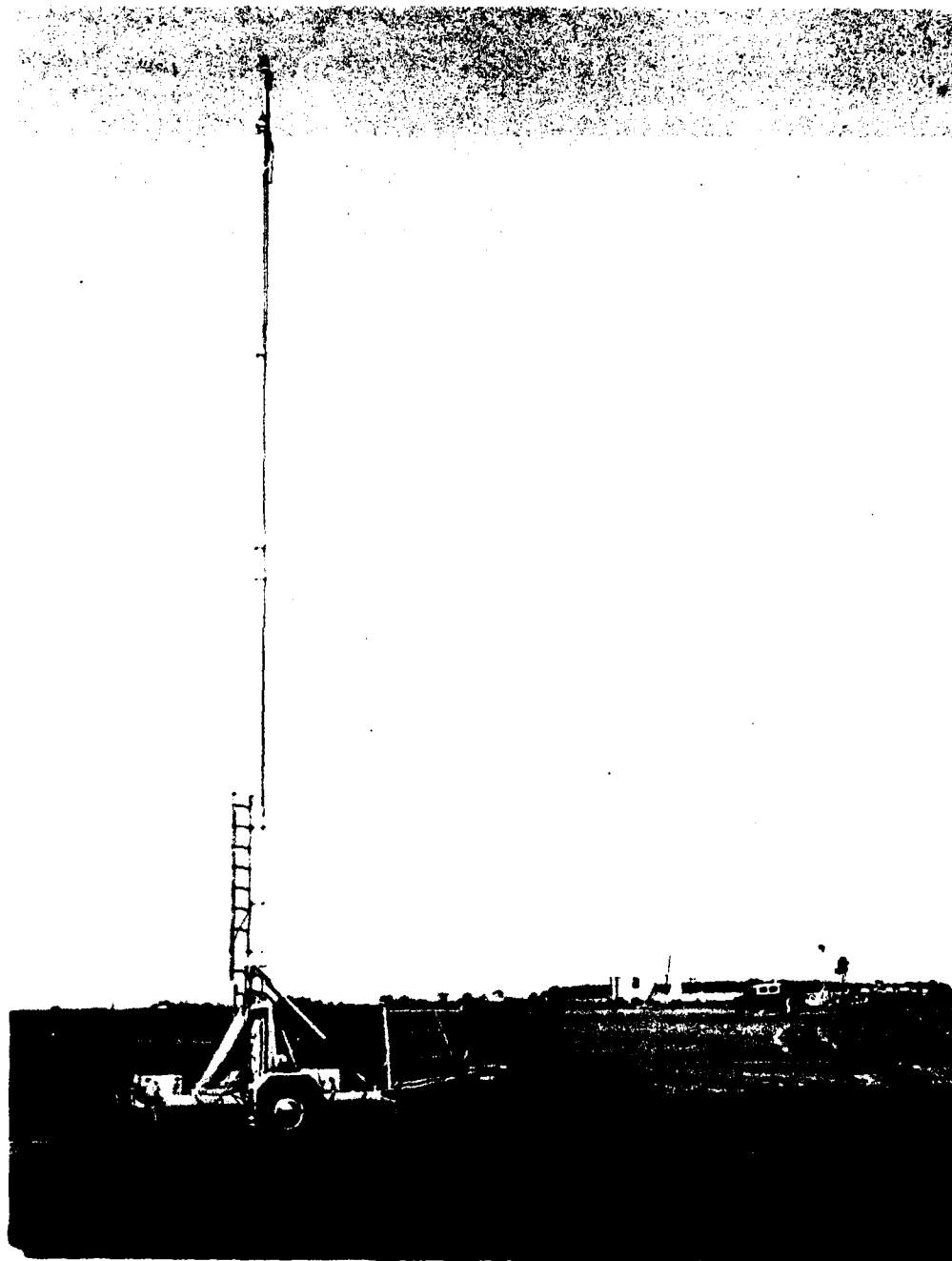


Fig 3.21 Elevation field monitor mounting

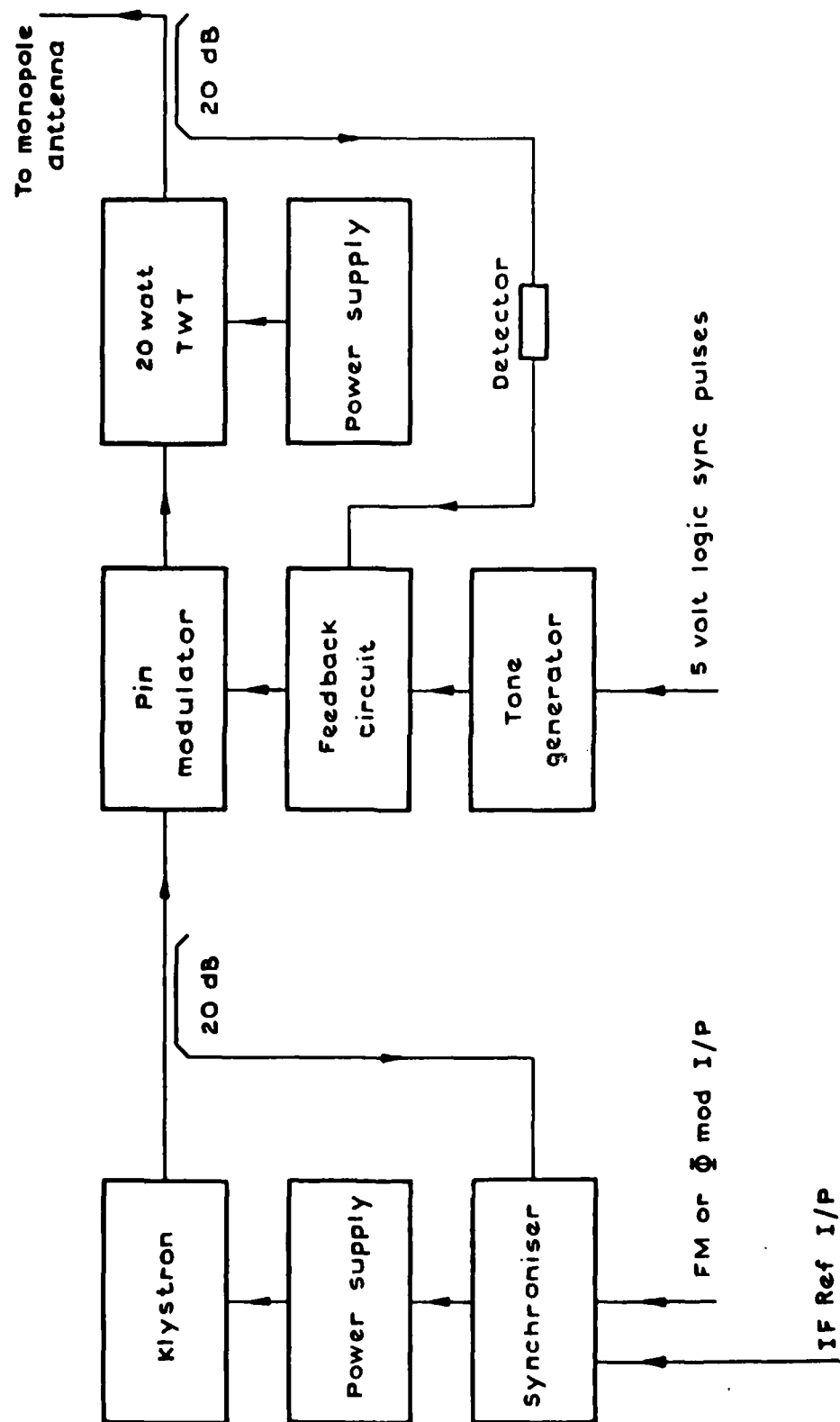


Fig 3.22

Fig 3.22 Data transmitter block diagram

Fig 3.23

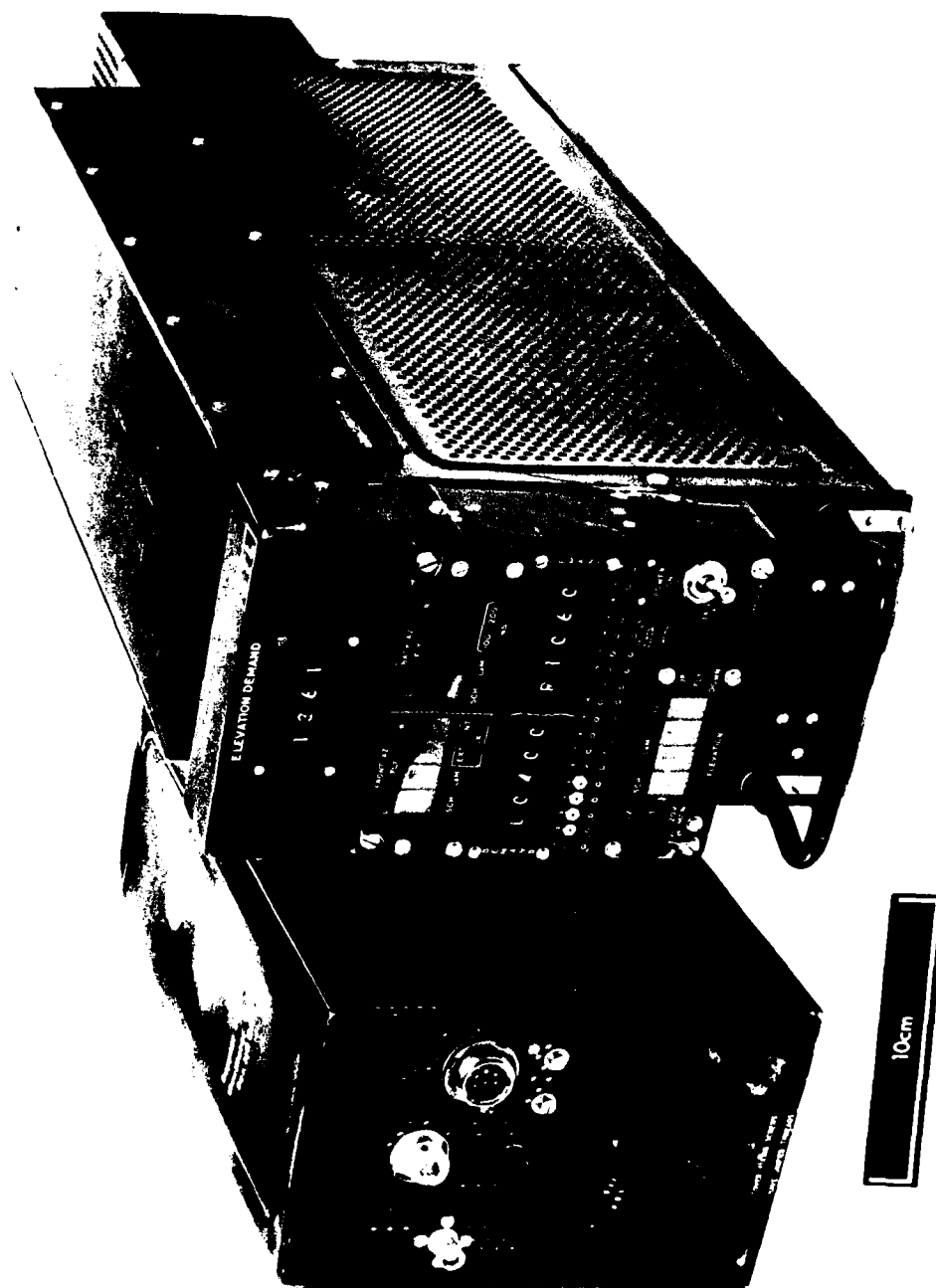


Fig 3.23 S type receiver system

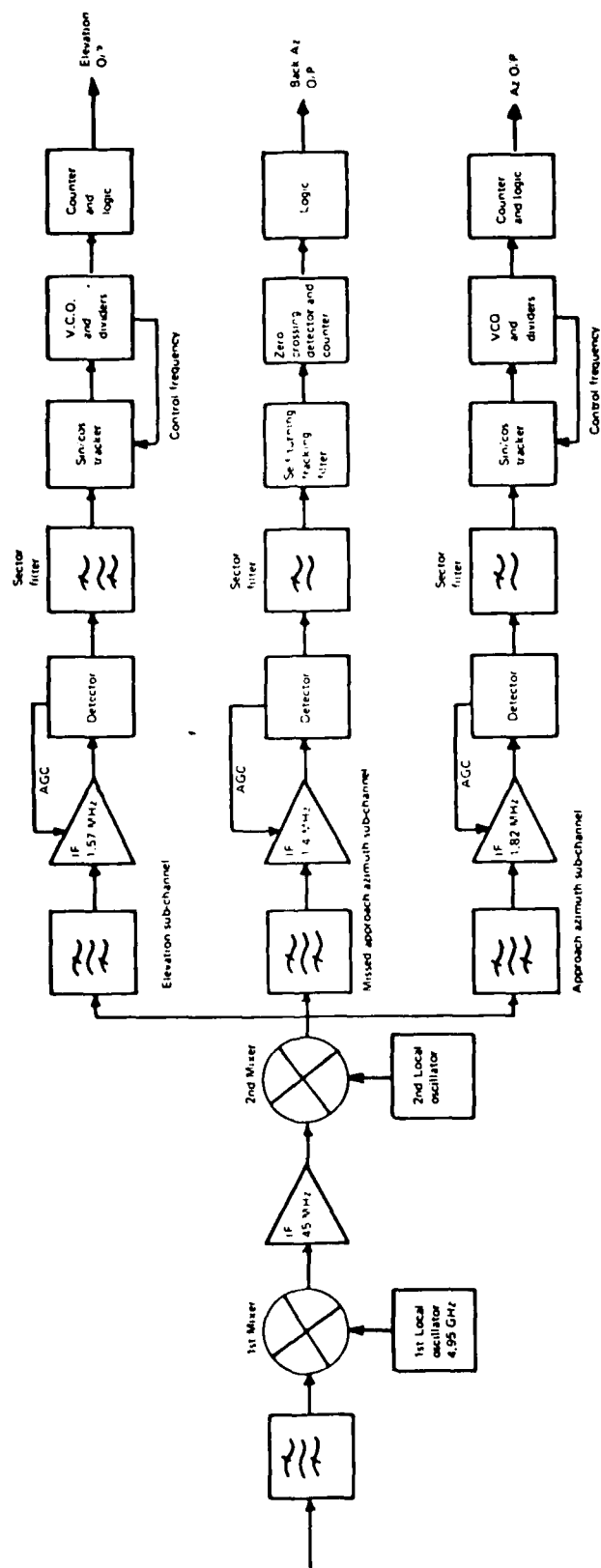


Fig 3.24 Outline block diagram of type S receiver

Fig 3.25

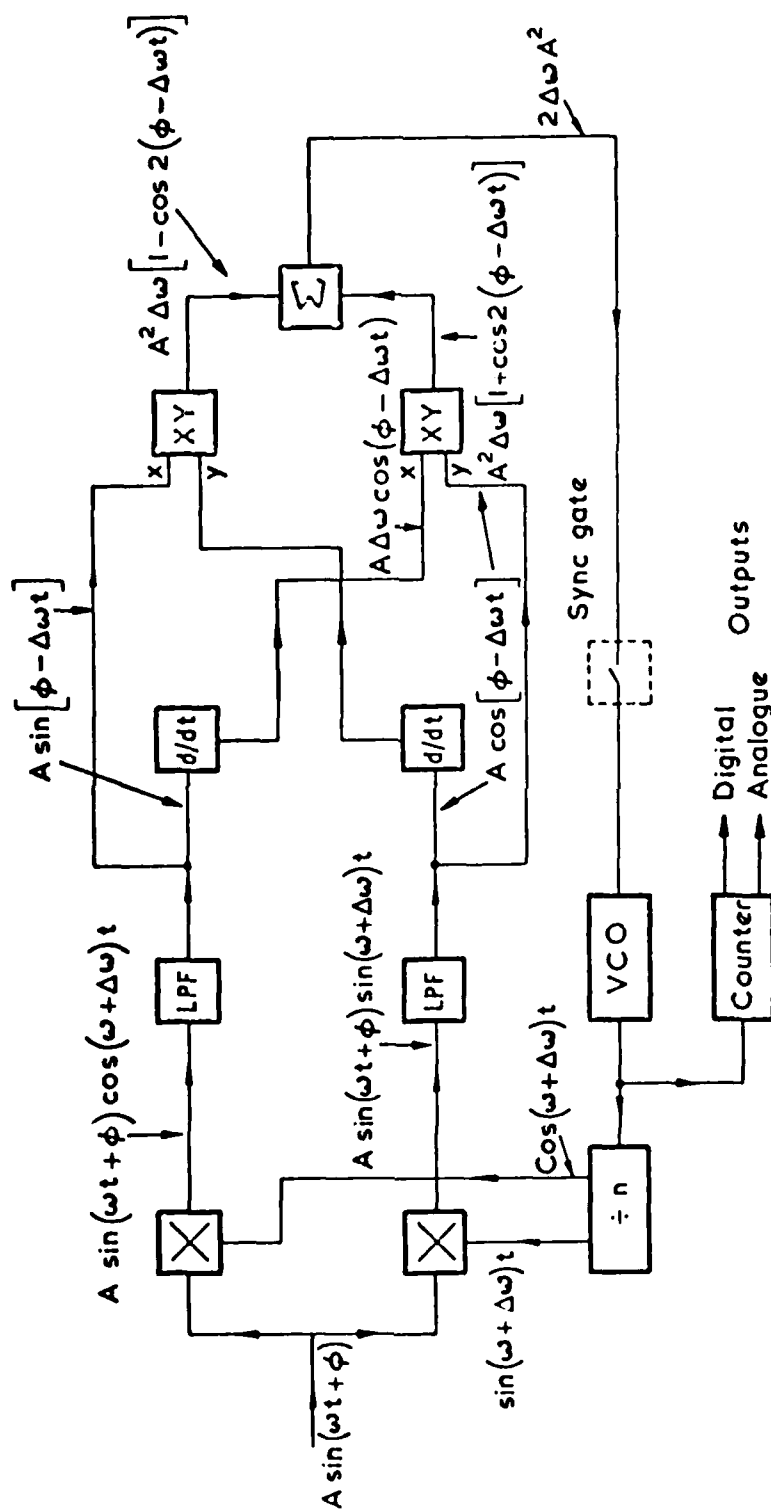


Fig 3.25 Sine/cosine tracker system detail diagram

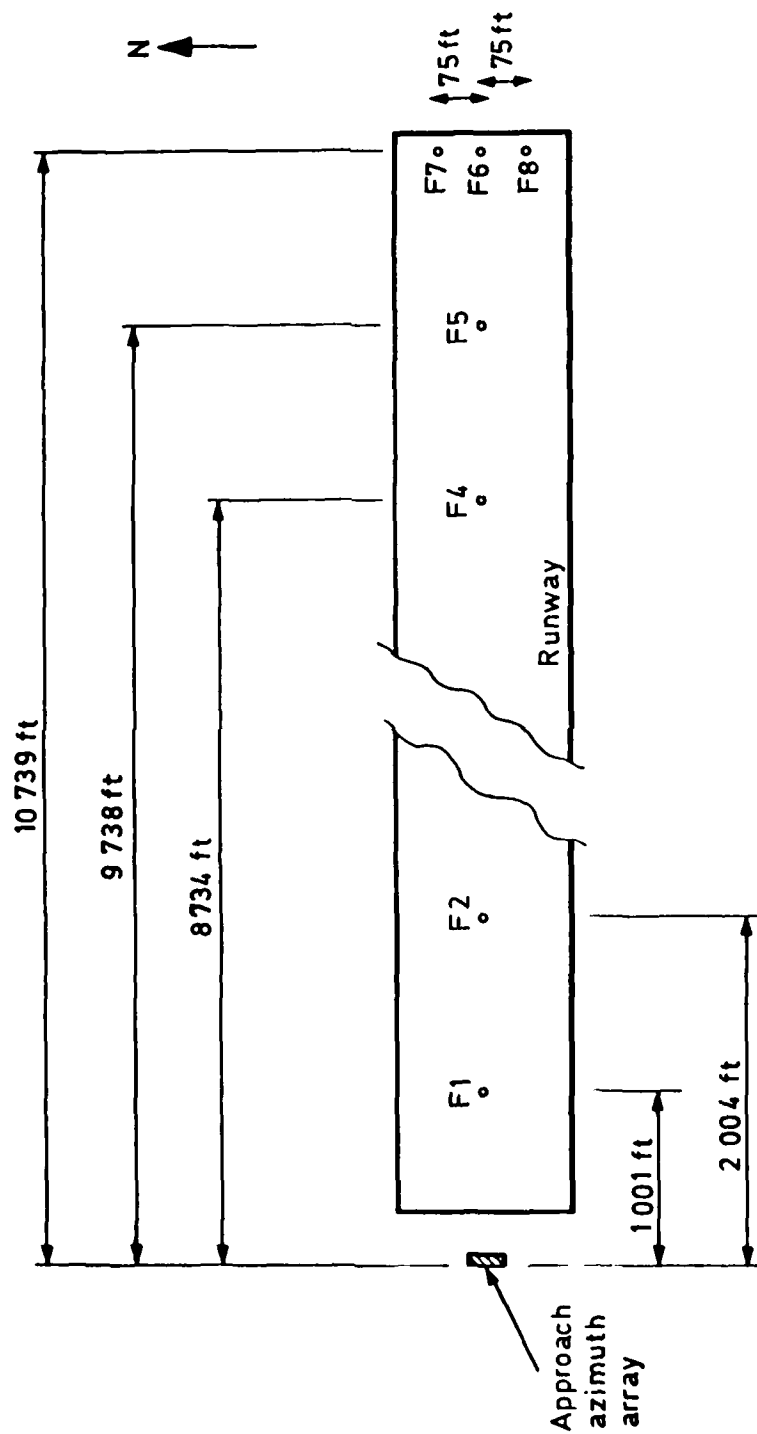


Fig 4.1a Close and long range approach azimuth test points

Fig 4.1b

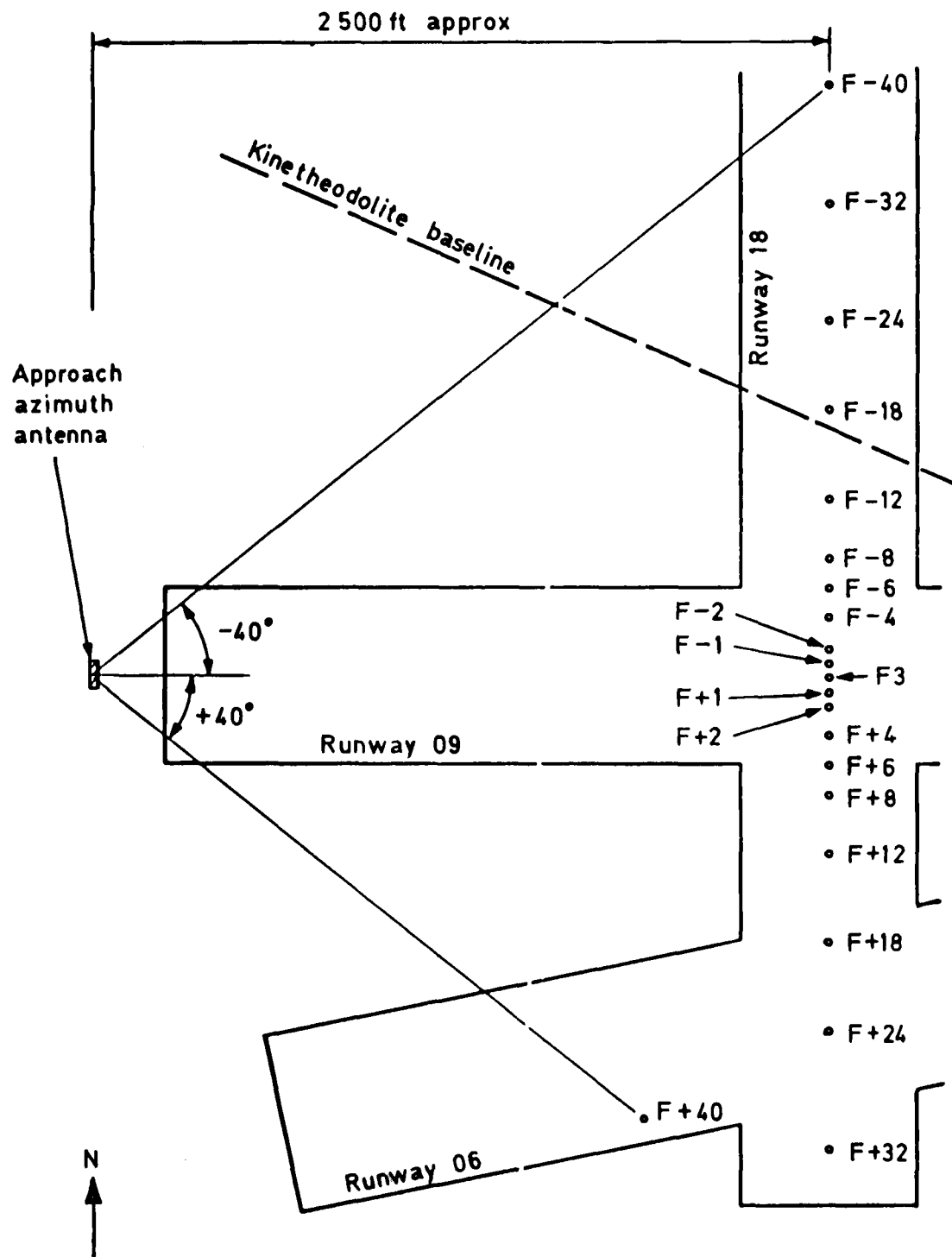


Fig 4.1b Cross runway approach azimuth test points

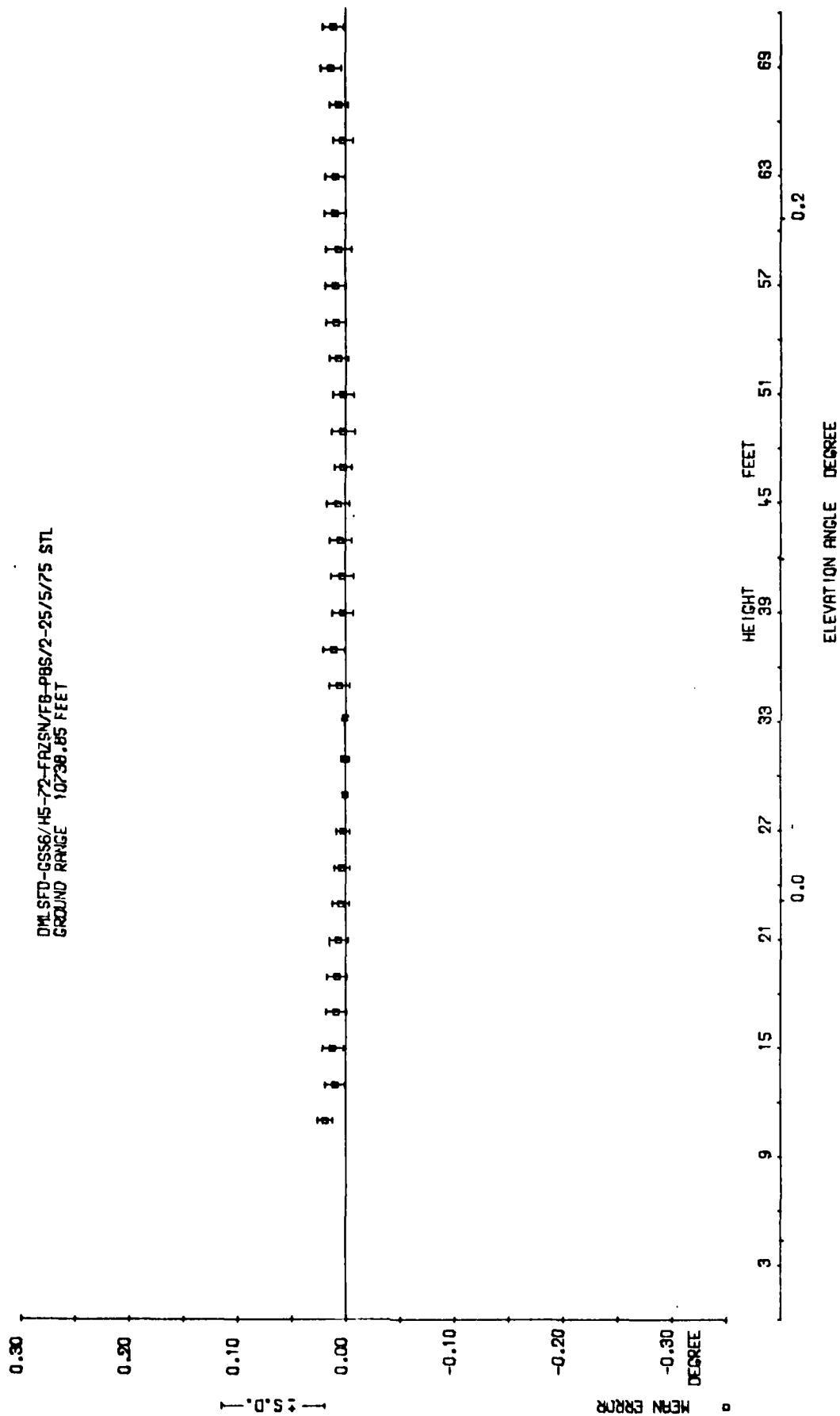


Fig 4.2

Fig 4.2 Approach azimuth static test GS56, position F6

Fig 4.3a

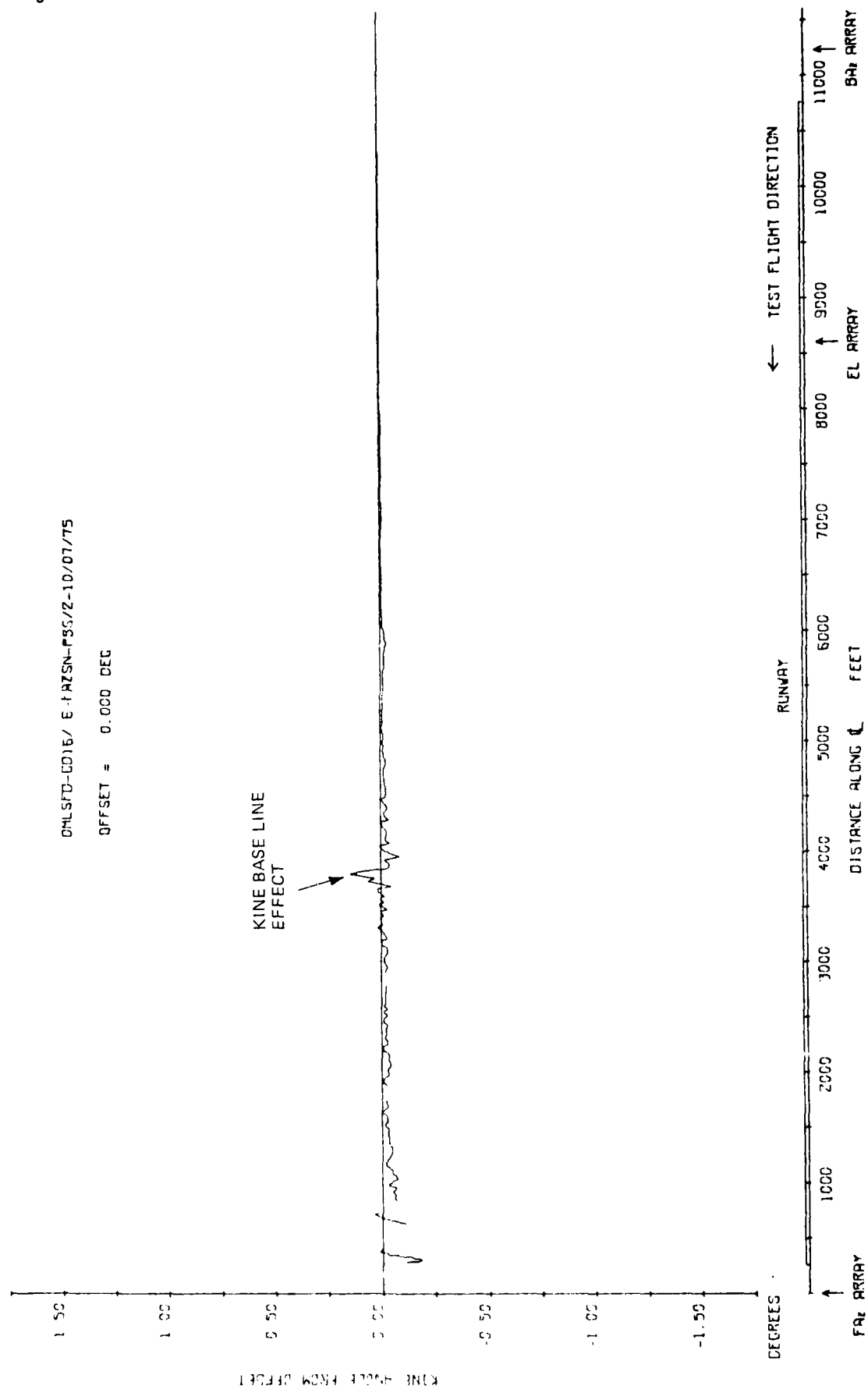


Fig 4.3a Approach azimuth. Vehicle run along test runway centre line.
 Mast height 20 ft



Fig 4.3c

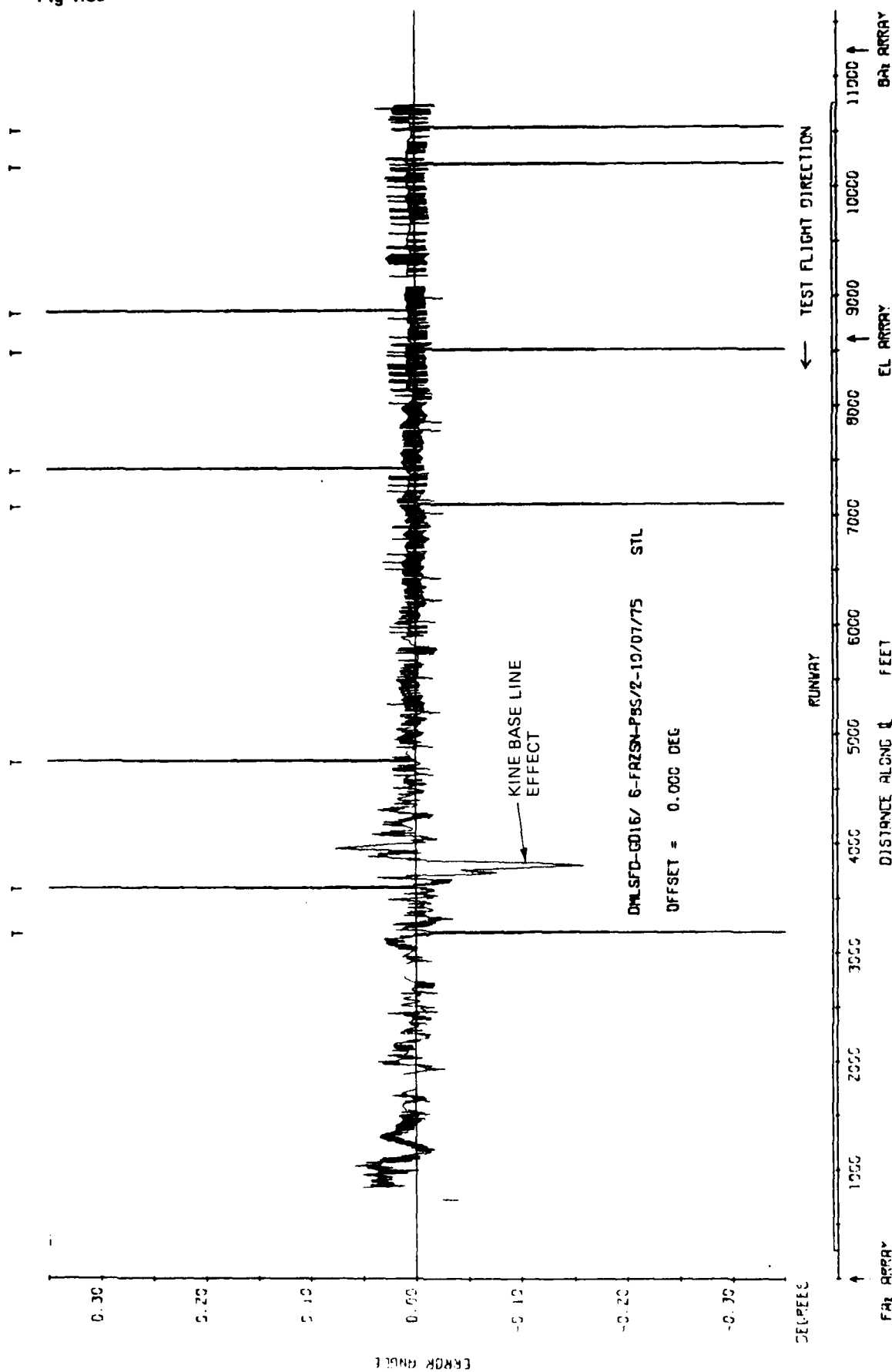


Fig 4.3c Approach azimuth. Vehicle run along test runway centre line. Mast height 20 ft

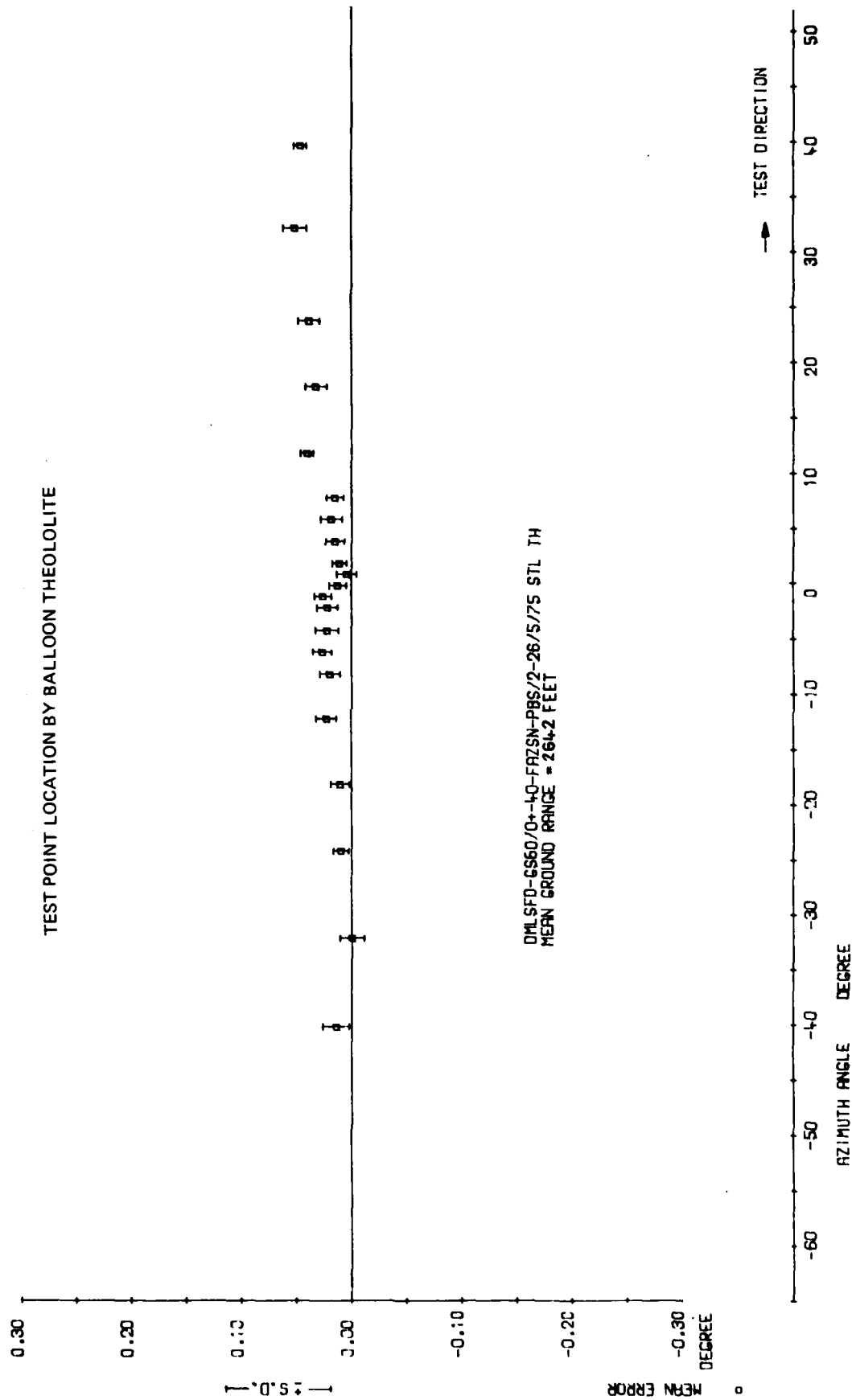


Fig 4.4

Fig 4.4 Approach azimuth cross runway test GS60

Fig 4.5a

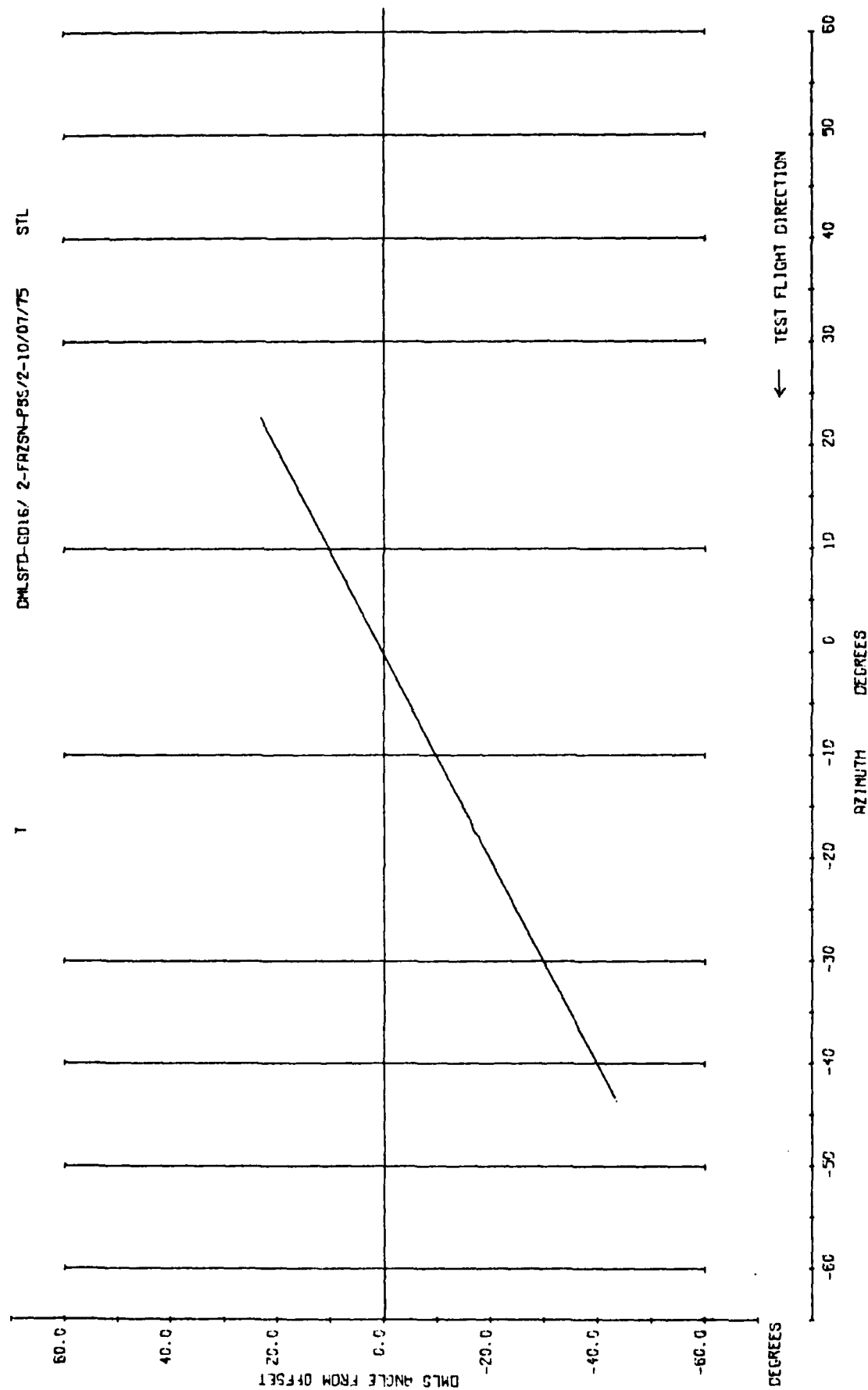


Fig 4.5a Approach azimuth. Vehicle run along N-S runway. Mast height 20 ft

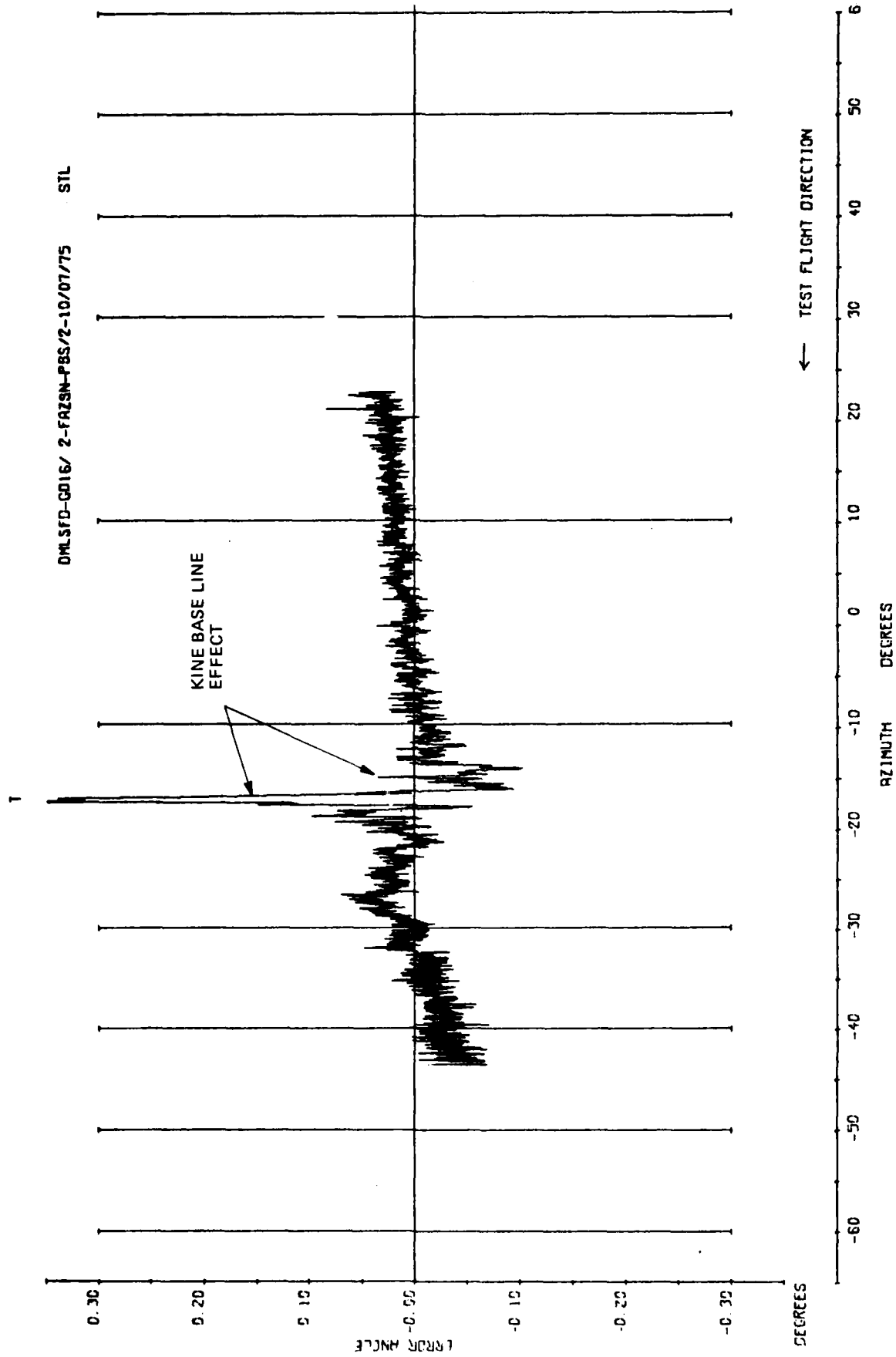


Fig 4.5b

Fig 4.5b Approach azimuth. Vehicle run along N-S runway. Mast height 20 ft

Fig 4.6a

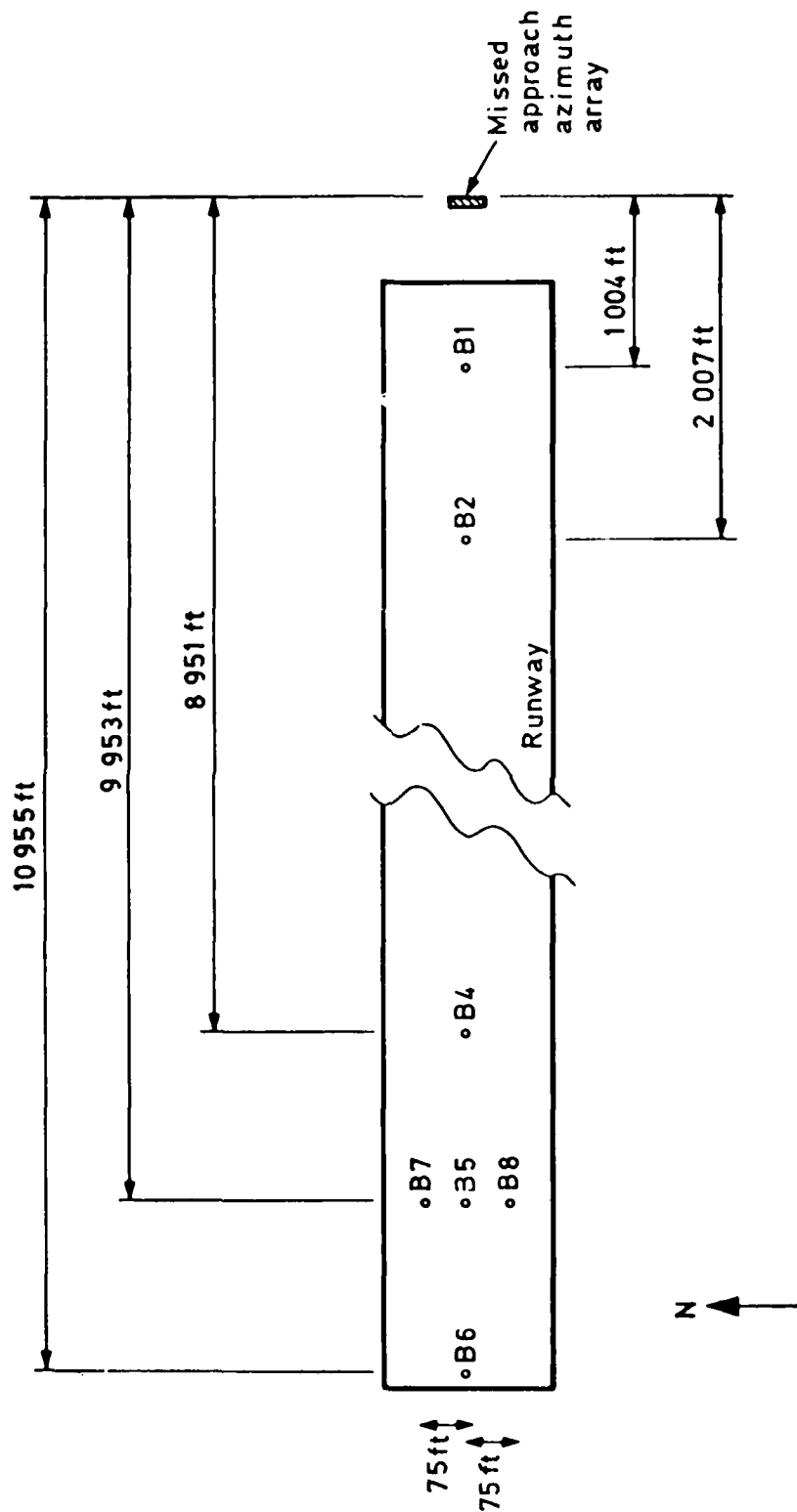


Fig 4.6a Close and long range missed approach azimuth test points

Fig 4.6b

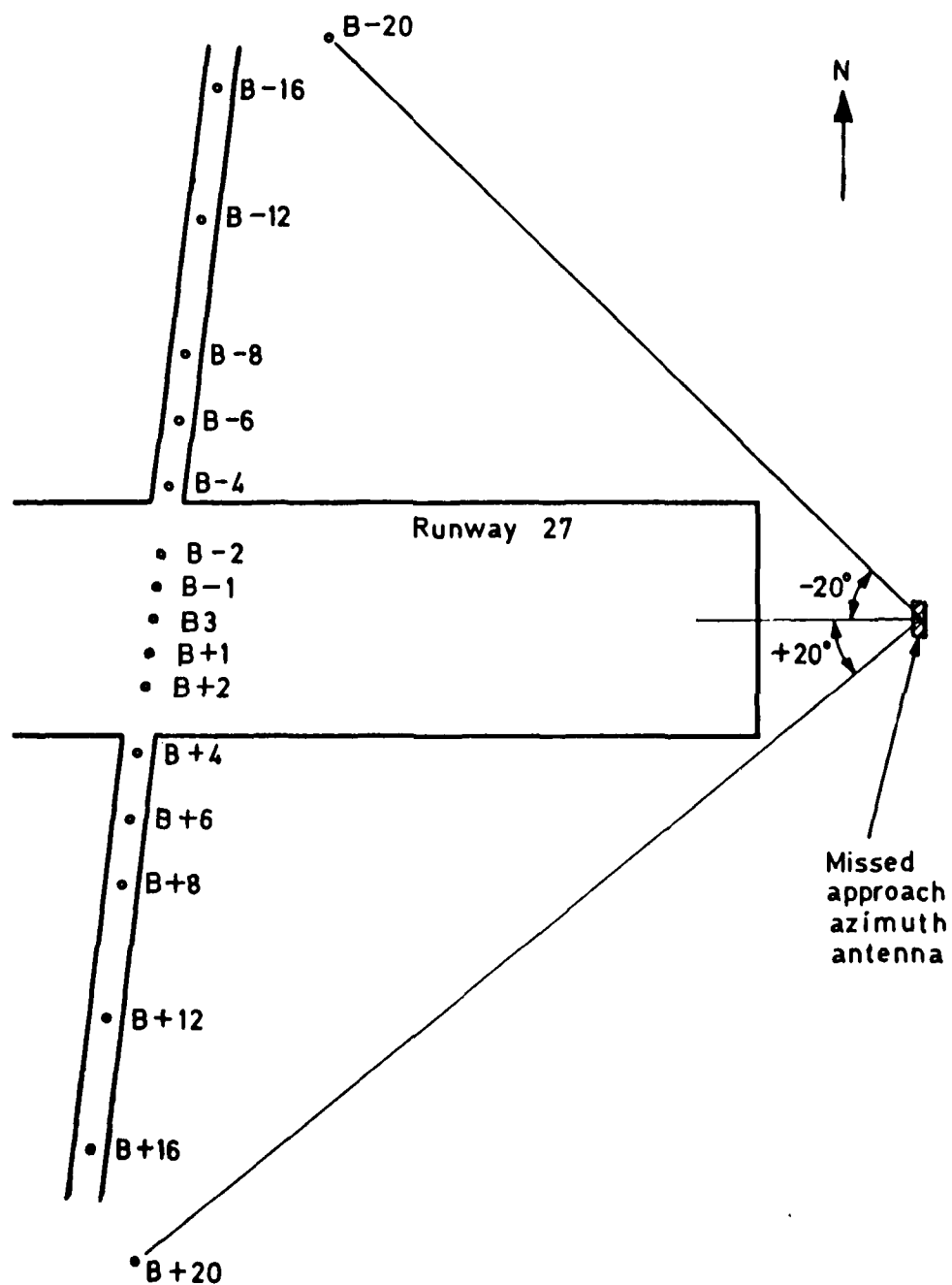


Fig 4.6b Cross runway missed approach azimuth test points

Fig 4.7

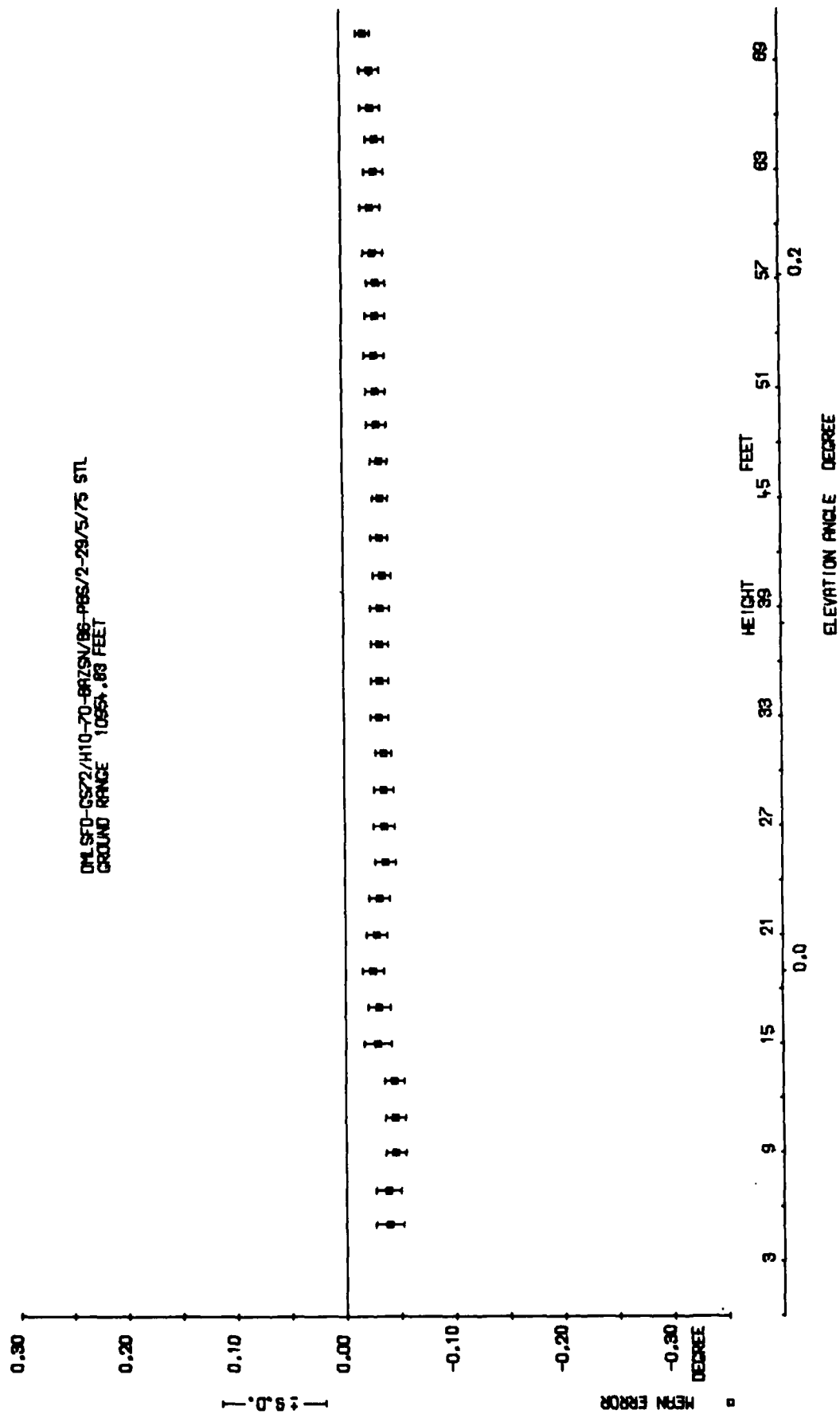


Fig 4.7 Missed approach azimuth static test GS72, position B6

DHLSFD-G016/ 6-94ZSN-P55/2-10/07/75

OFFSET = 0.000 DEG

KINE ANGLE FROM OFFSET

KINE BASE LINE
EFFECT

DEGREES

RUNWAY

← TEST FLIGHT DIRECTION

FAI ARRAY

DISTANCE ALONG FEET

EL ARRAY

SAI ARRAY

Fig 4.8a

Fig 4.8a Missed approach azimuth. Run along test runway centre line.
Mast at 20 ft

Fig 4.8b

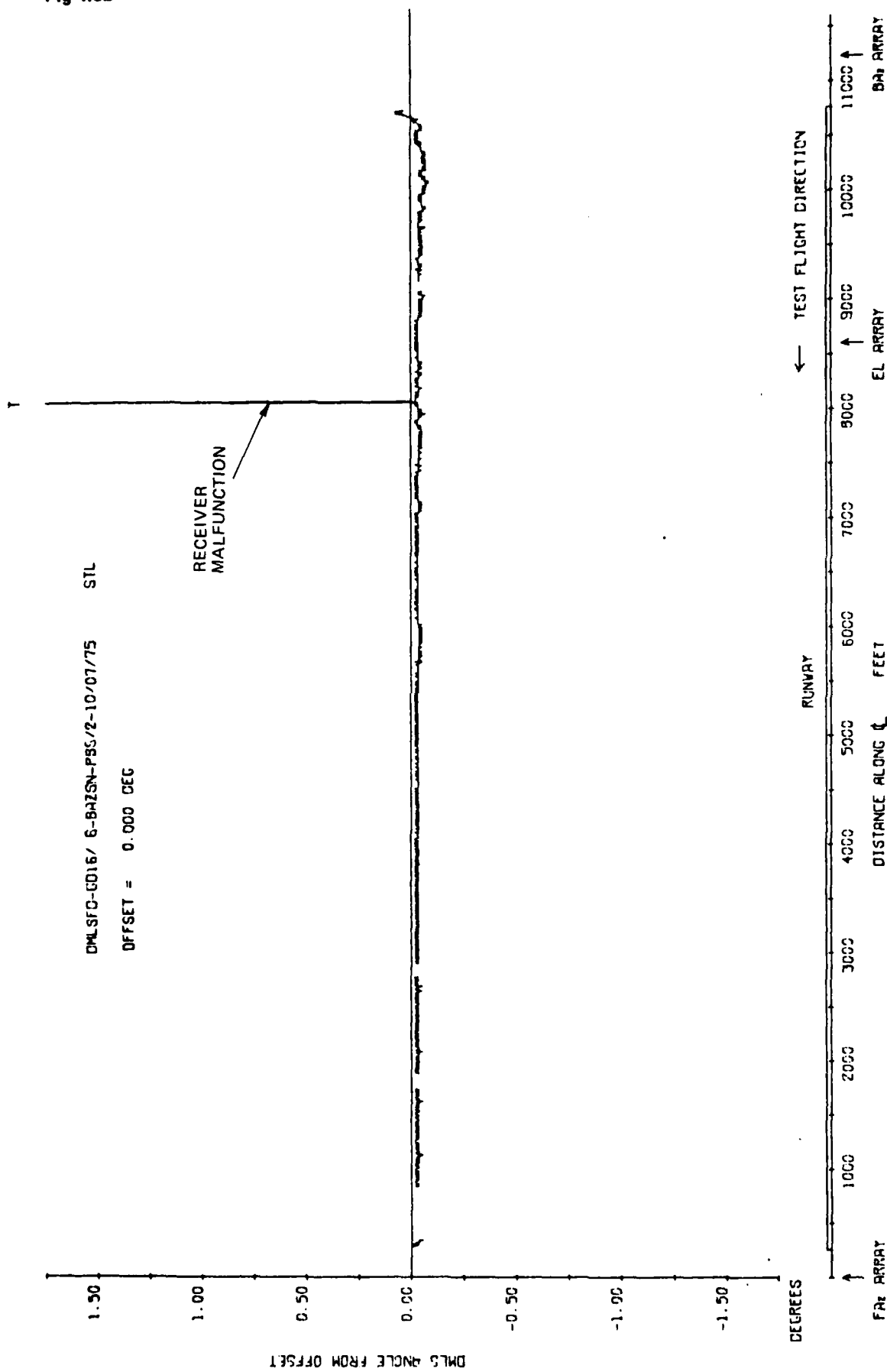


Fig 4.8b Missed approach azimuth. Run along test runway centre line. Mast at 20 ft

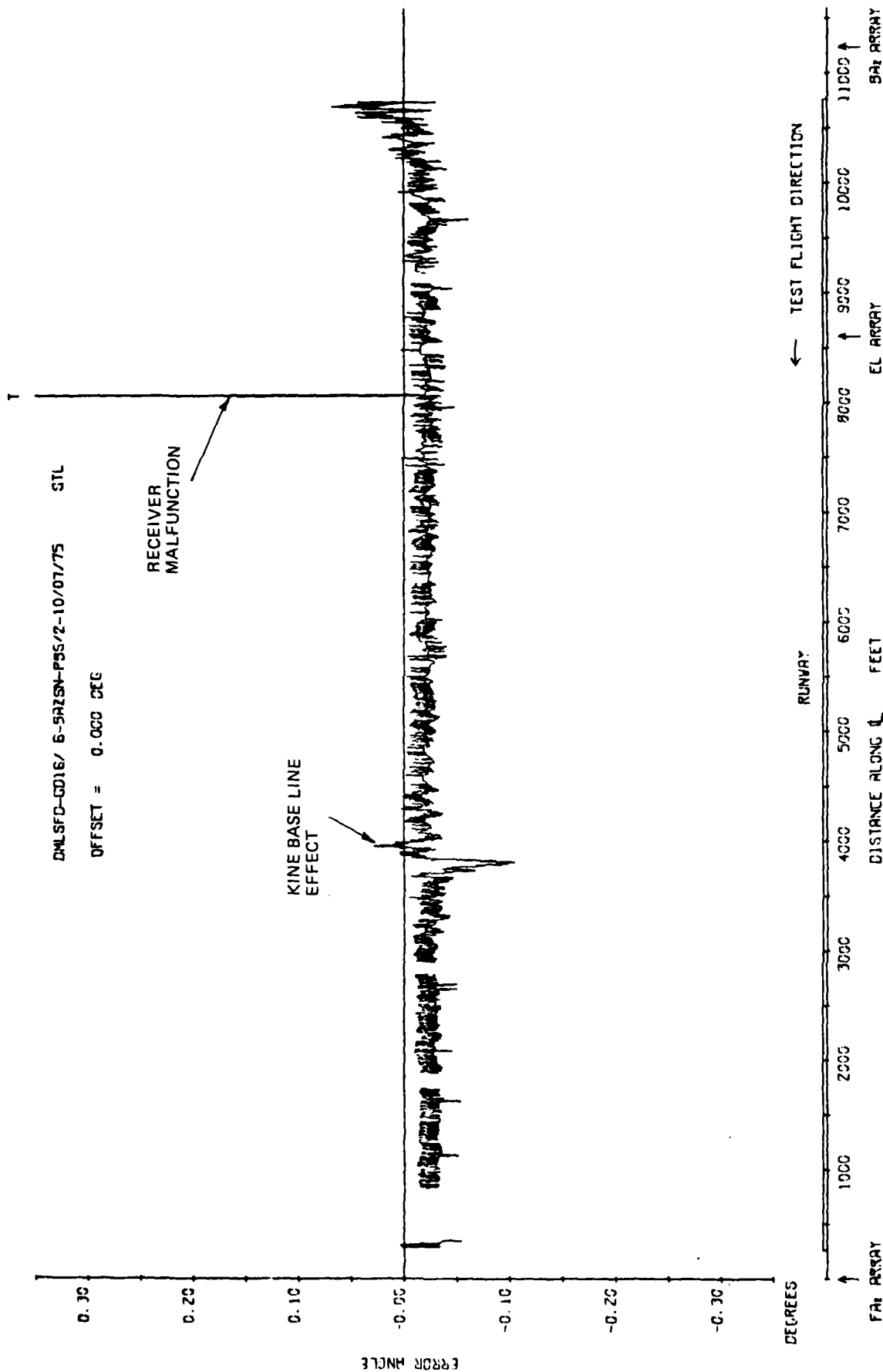


Fig 4.8c

Fig 4.8c Missed approach azimuth. Run along test runway centre line. Mast at 20 ft

Fig 4.9

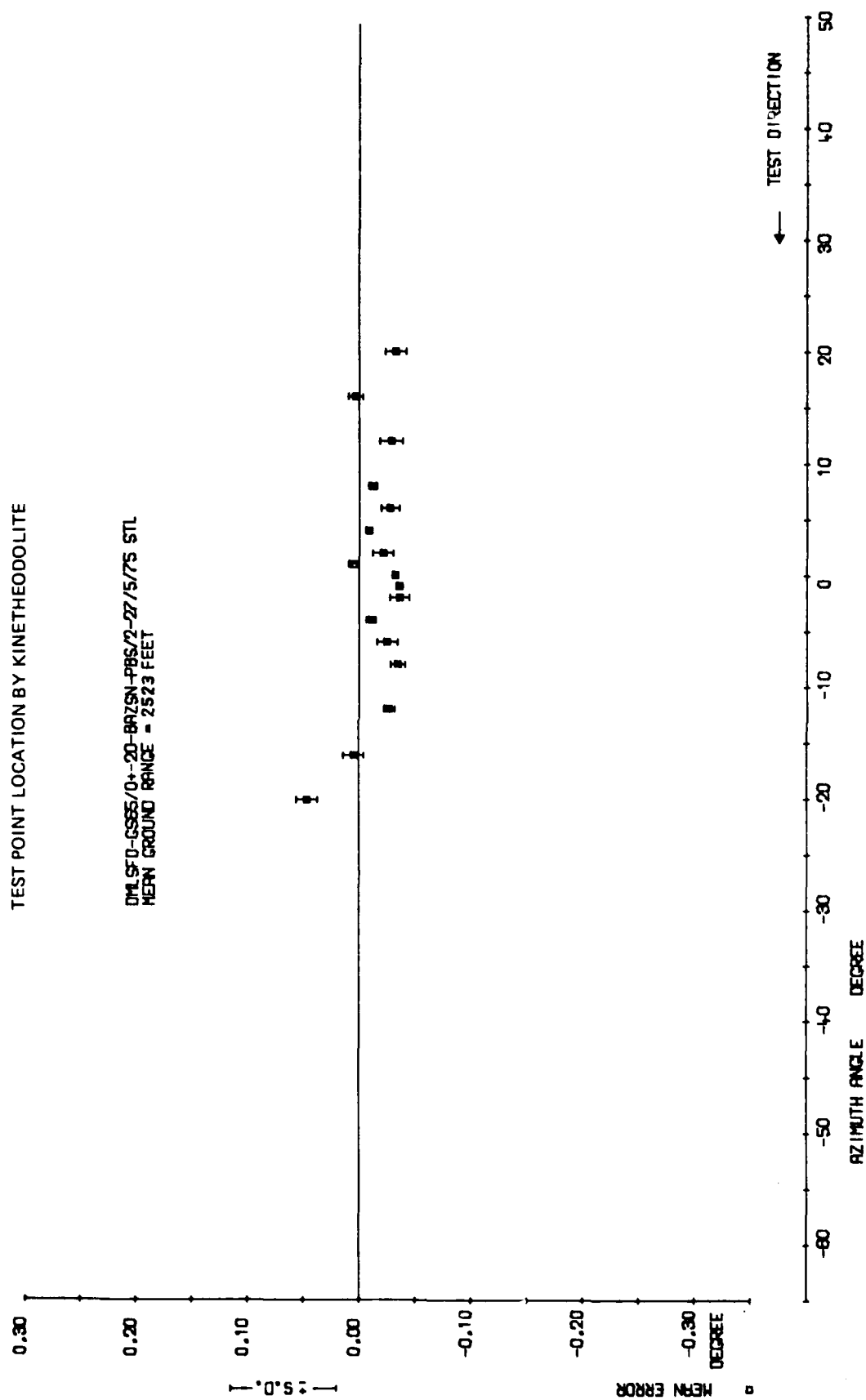


Fig 4.9 Missed approach azimuth cross runway test GS65

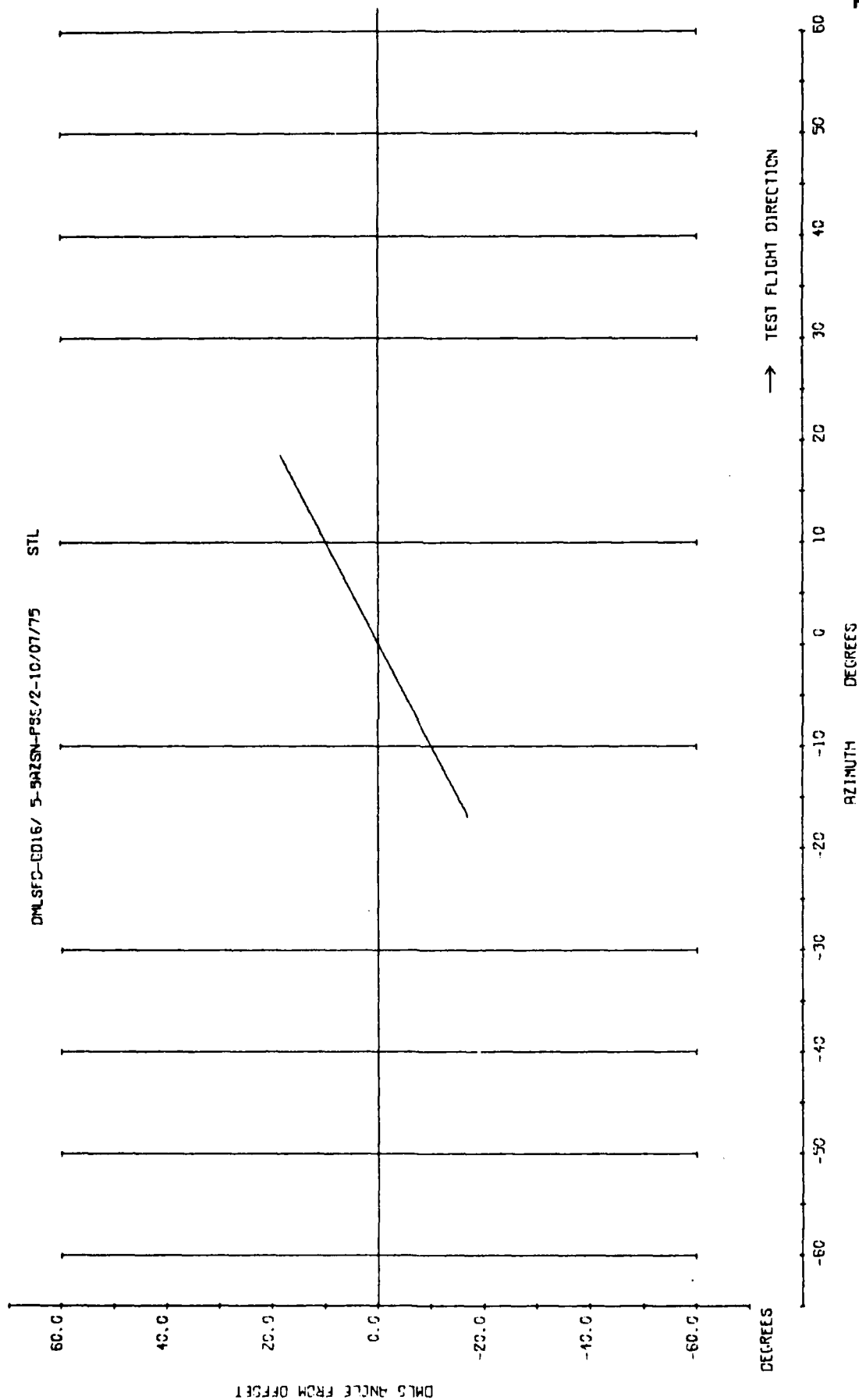


Fig 4.10a

Fig 4.10a Missed approach azimuth. Vehicle run along cross road.
Mast height 20 ft

Fig 4.10b

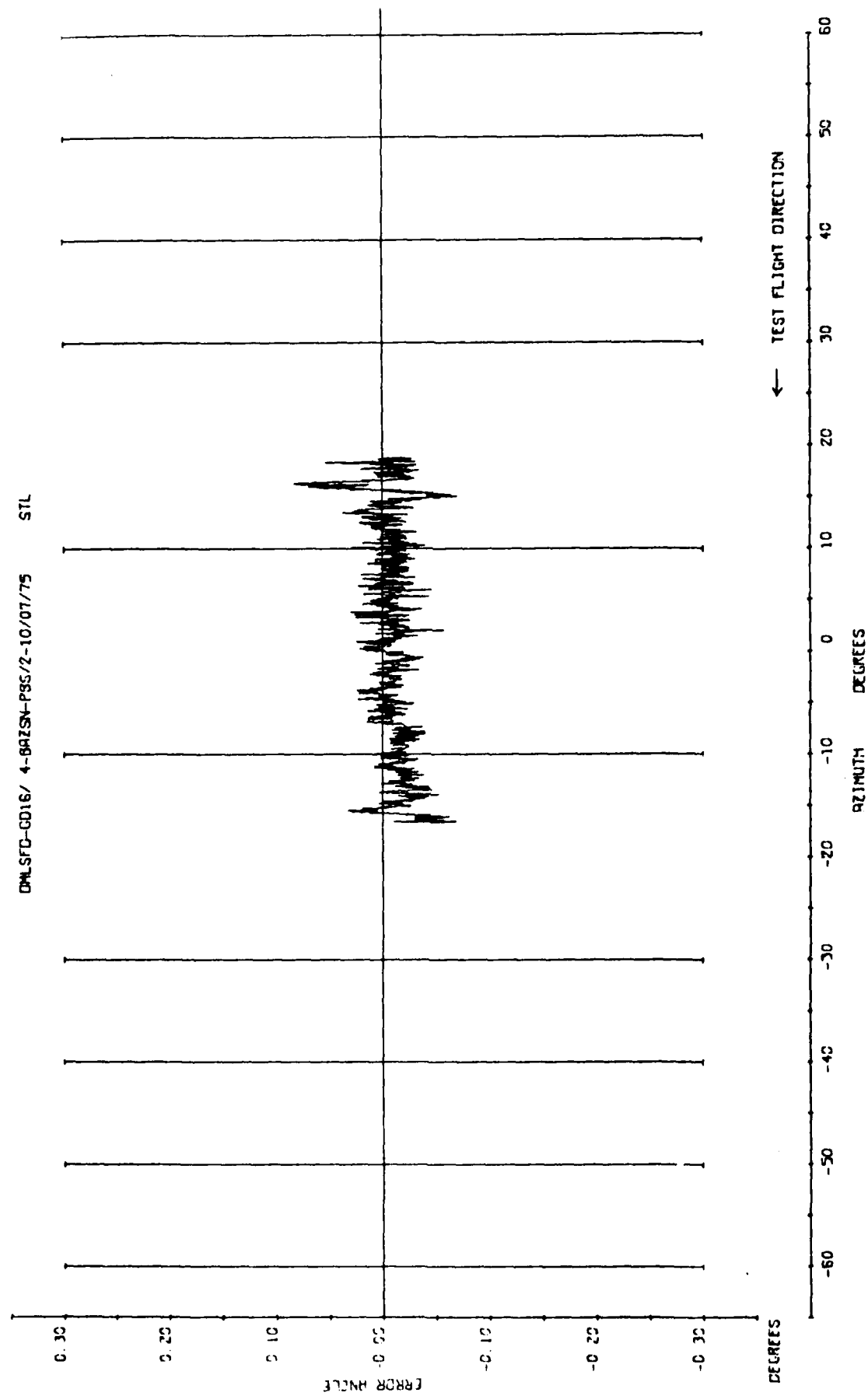


Fig 4.10b Missed approach azimuth. Vehicle run along cross road.
Mast height 30 ft

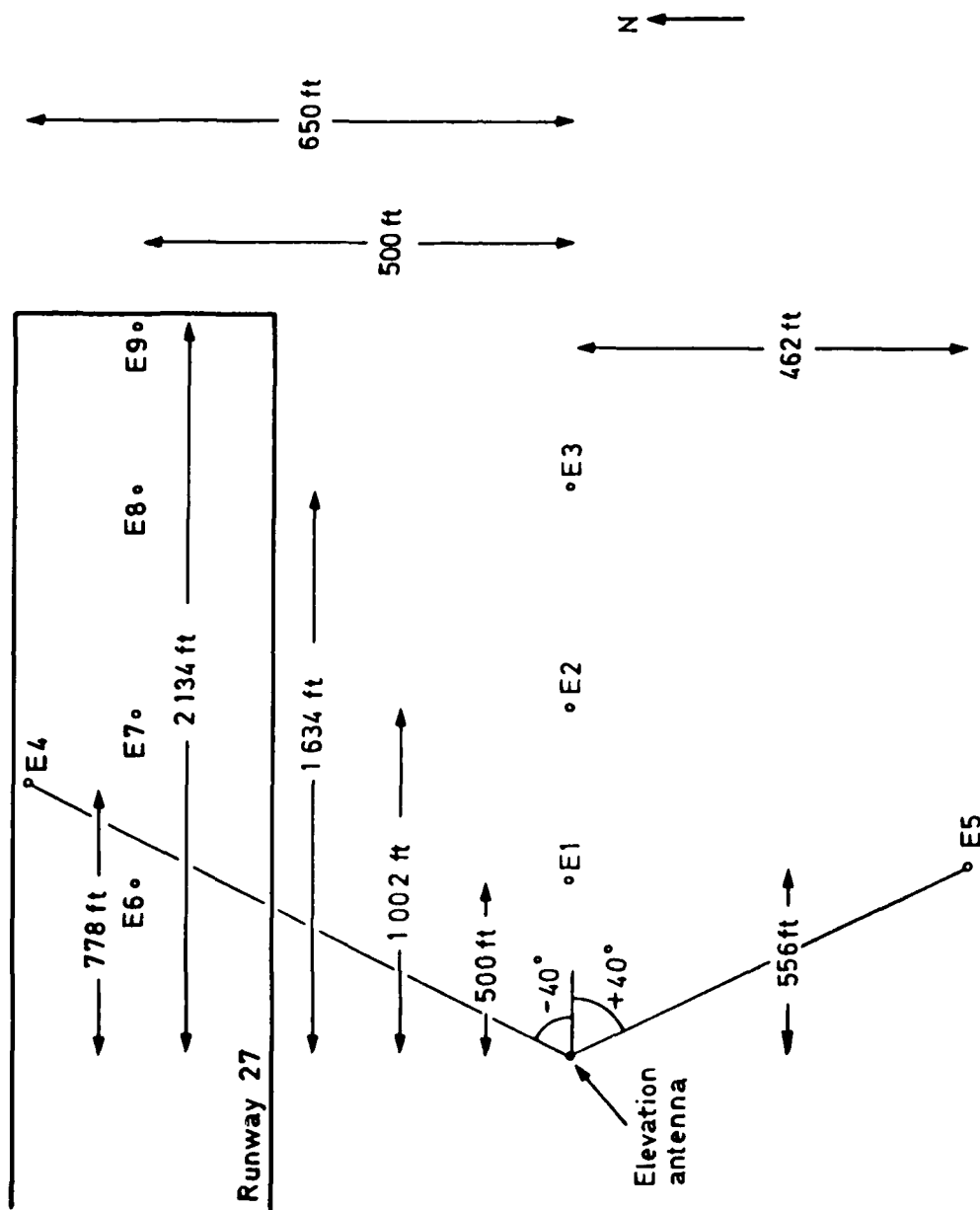


Fig 4.11 Elevation test points

Fig 4.12

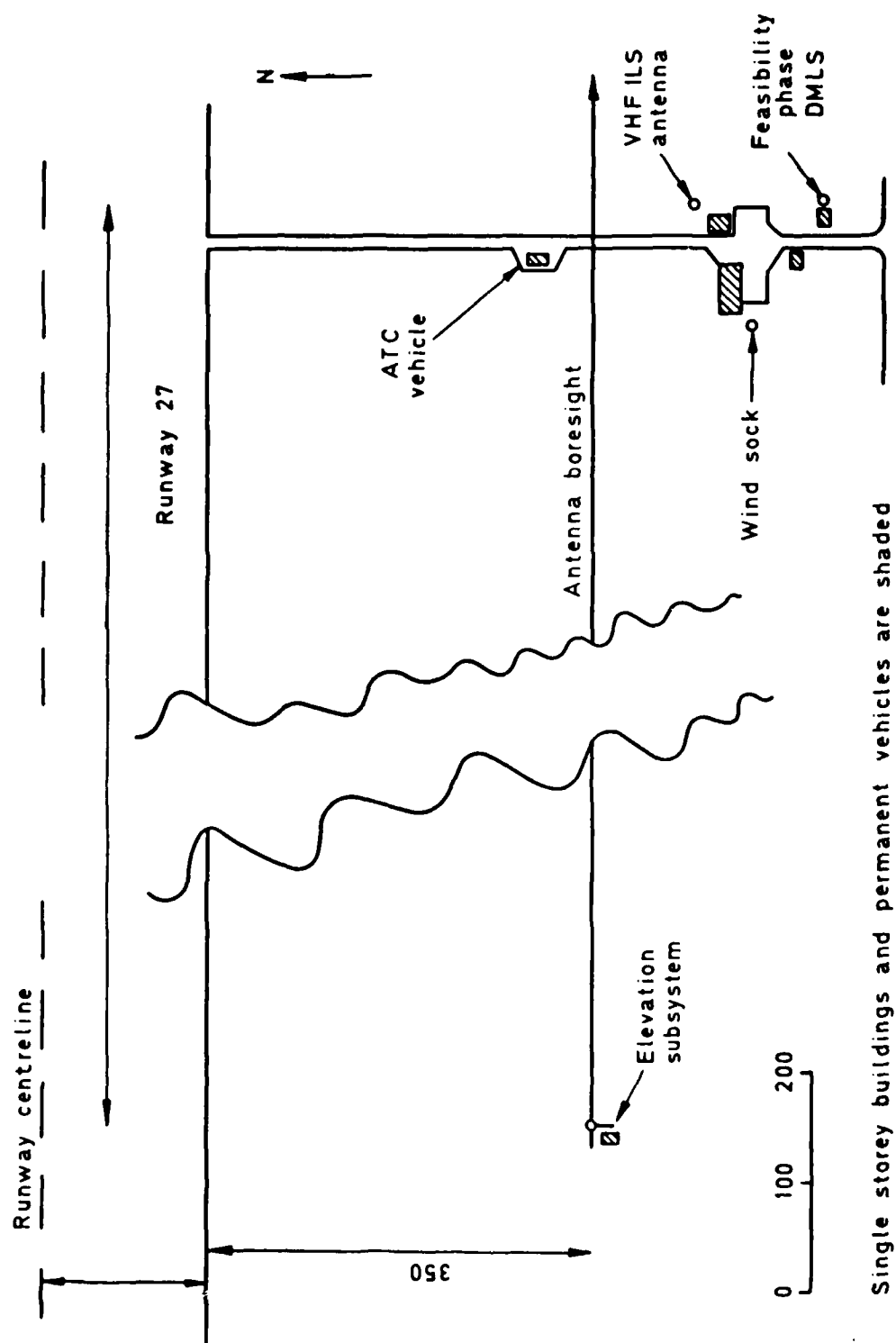


Fig 4.12 Elevation sub-system installation

Fig 4.13

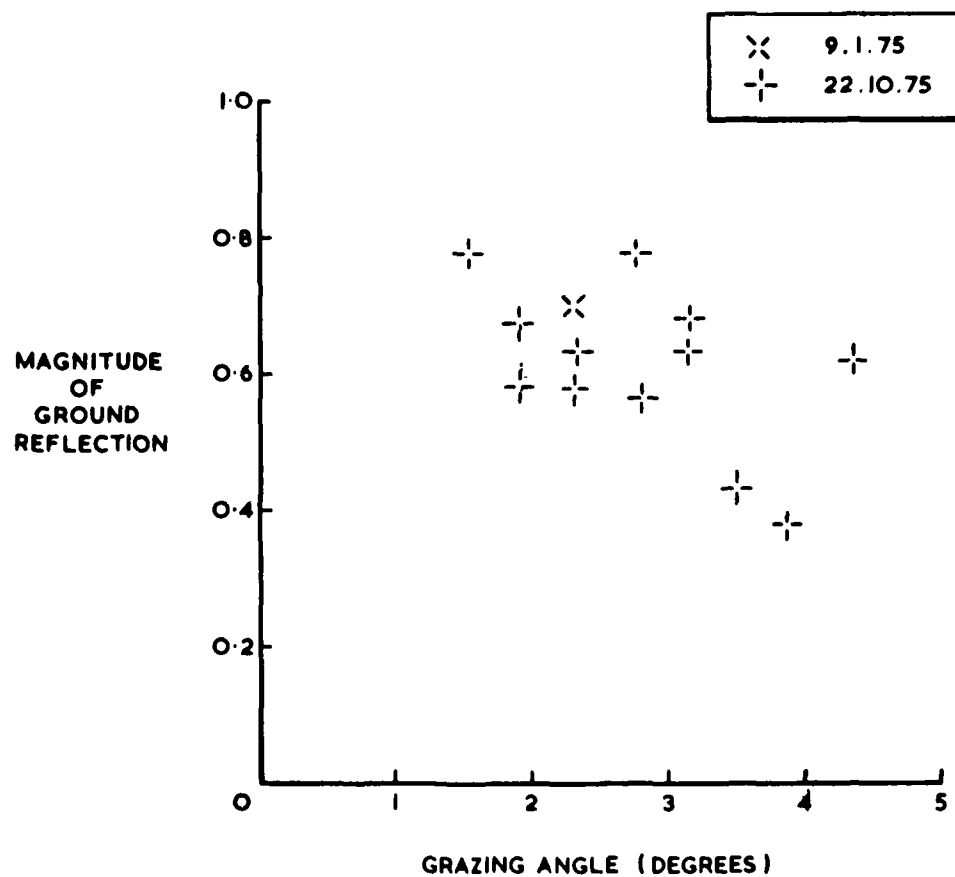


Fig 4.13 Magnitude of ground reflection in front of elevation transmitter.
Range 1000 ft

Fig 4.14

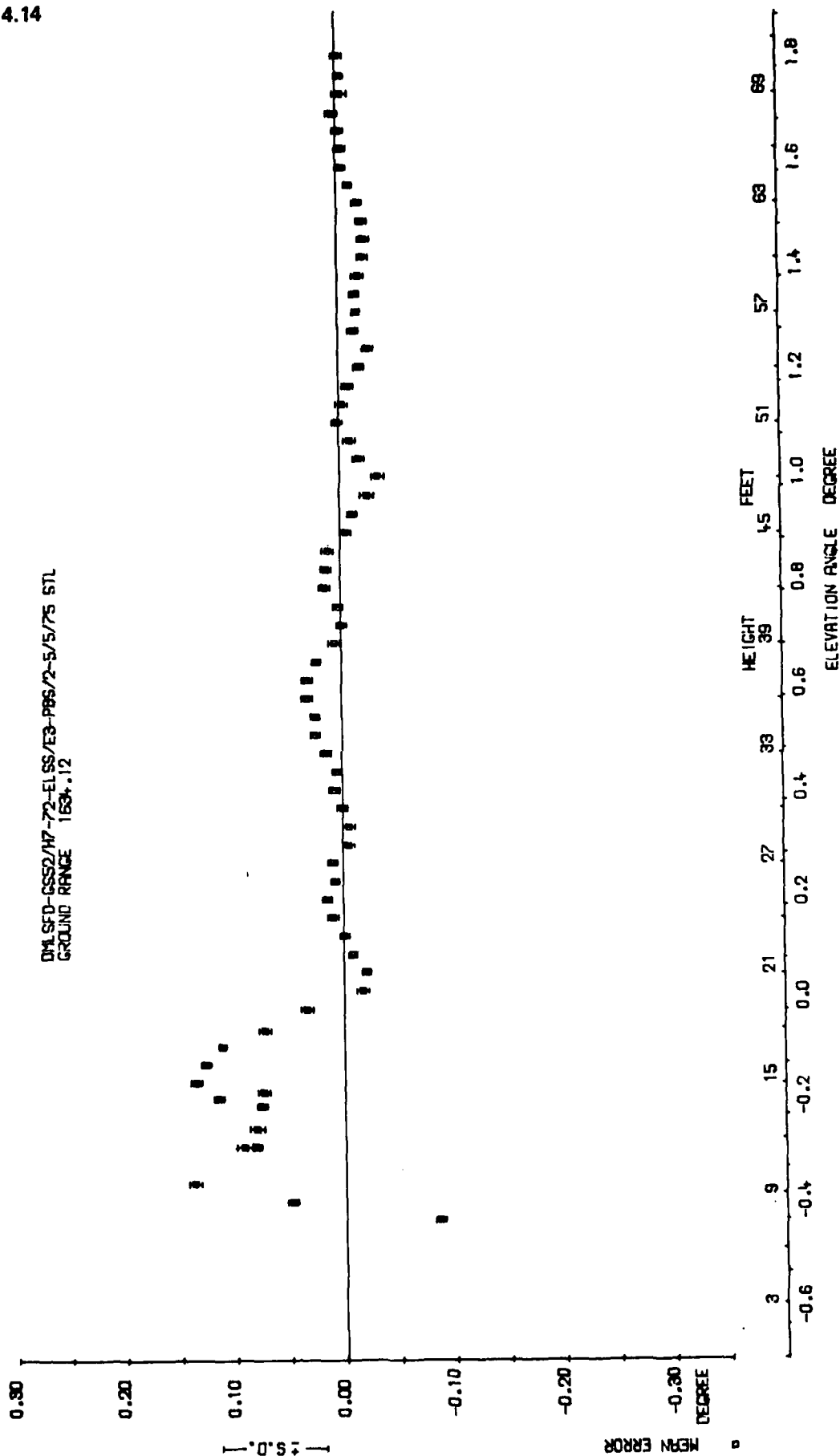


Fig 4.14 Elevation static test GS52, position E3

DML STD-CSA.0/H16-65-EL /E7-PBS/ -12/2/75 STL
GROUND RANGE 1122.93

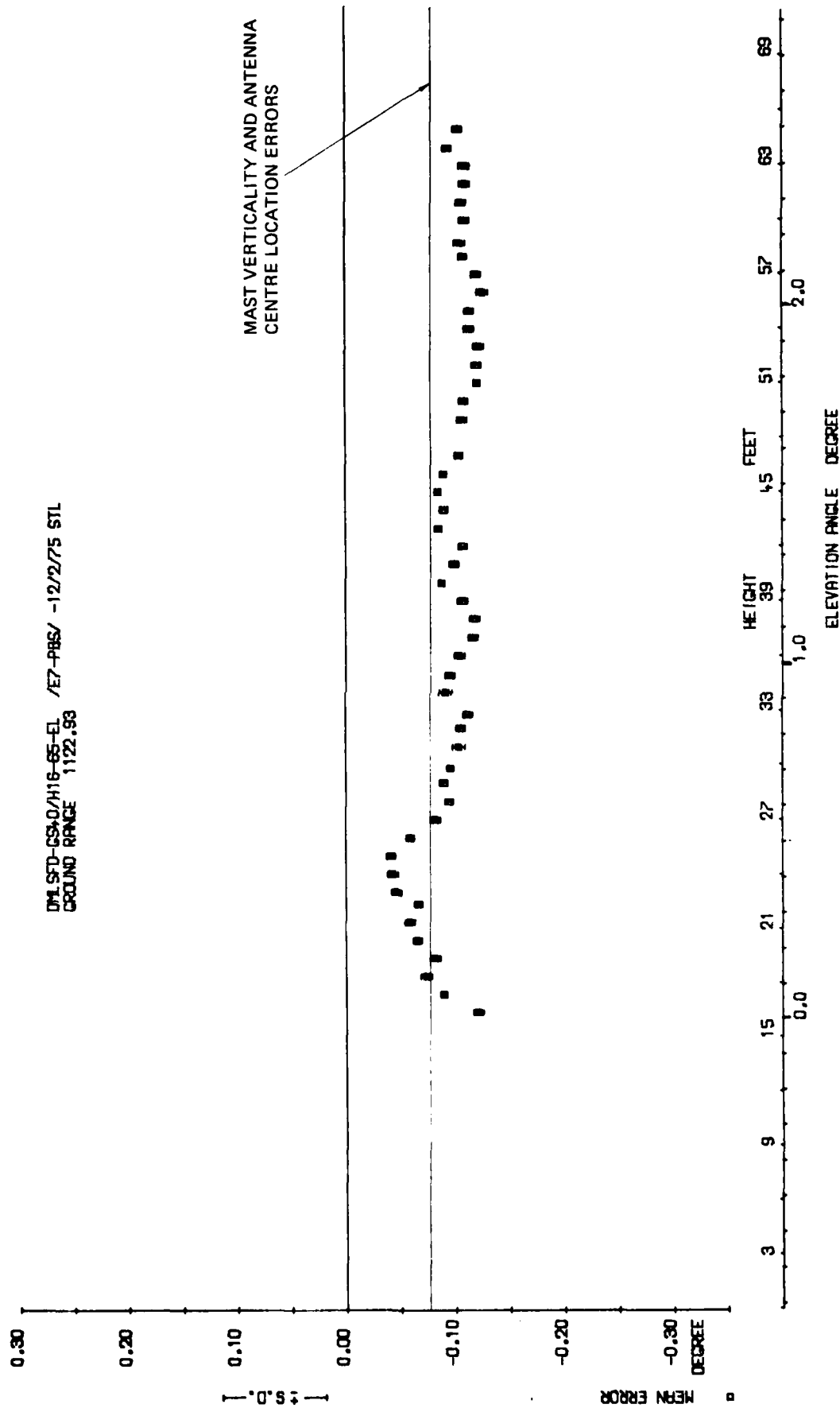


Fig 4.15a

Fig 4.15a Elevation static test GS40, position E7

Fig 4.15b

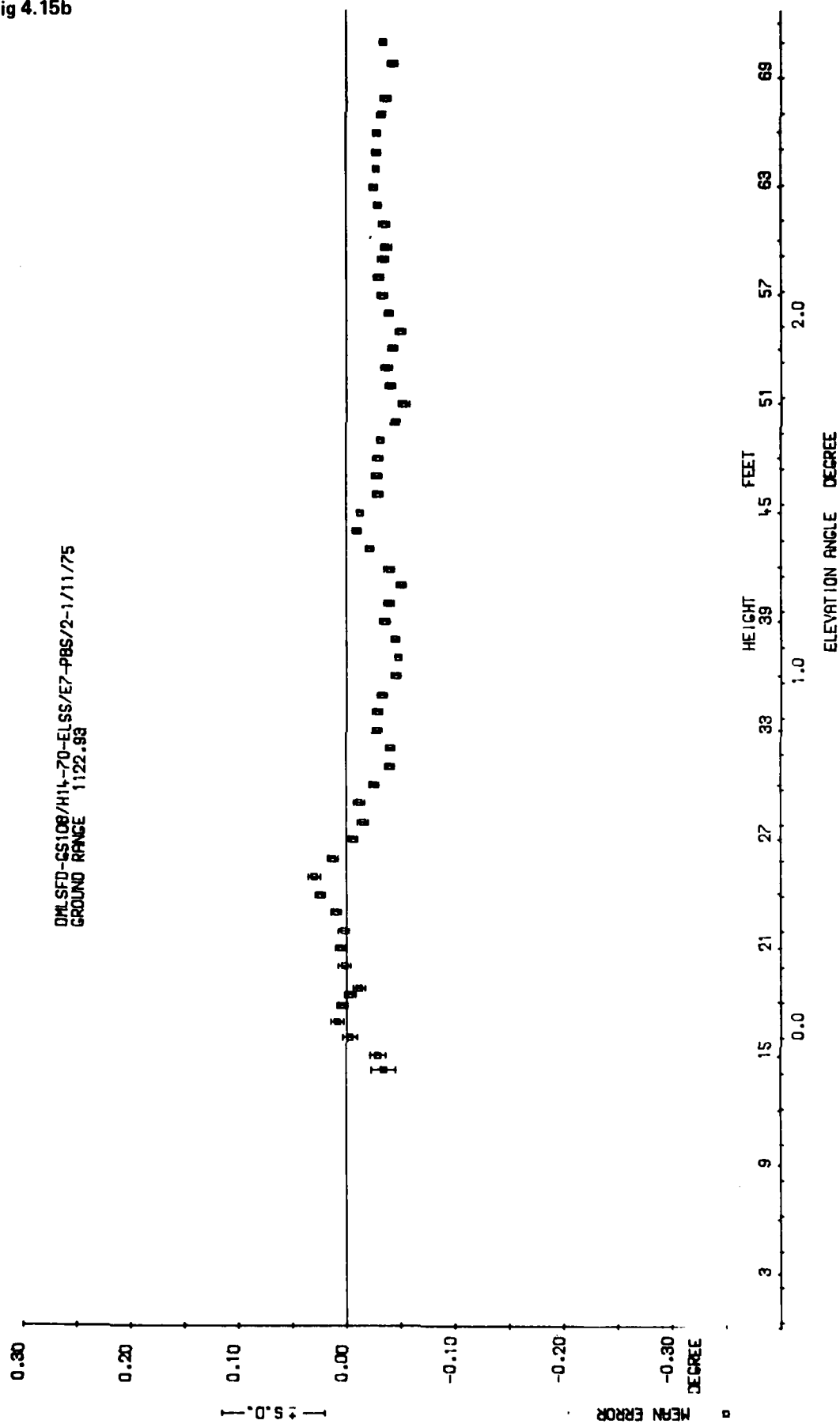


Fig 4.15b Elevation static test GS108, position E7

Fig 4.16a

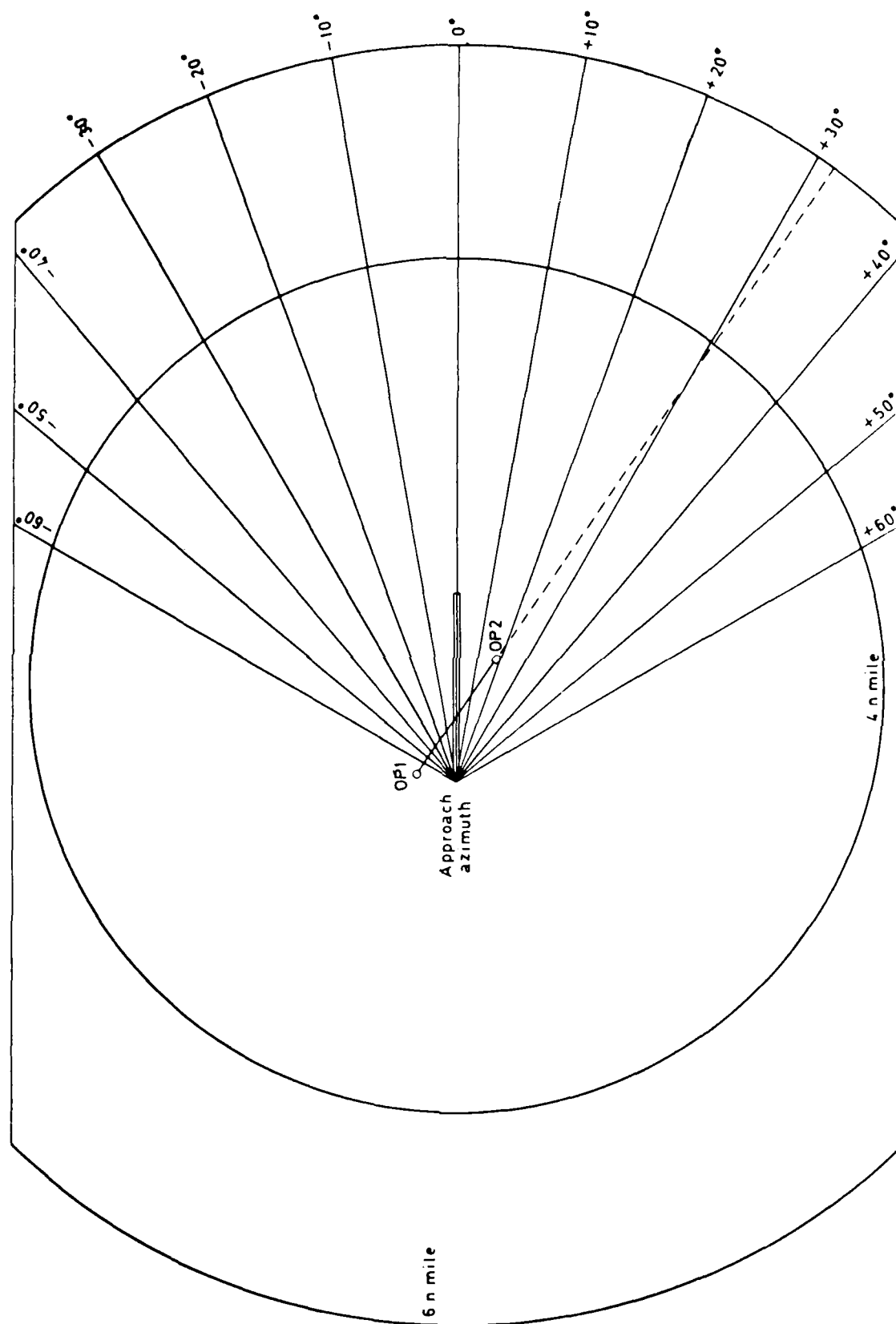


Fig 4.16a Kine base line in relation to approach azimuth flight paths

Fig 4.16b

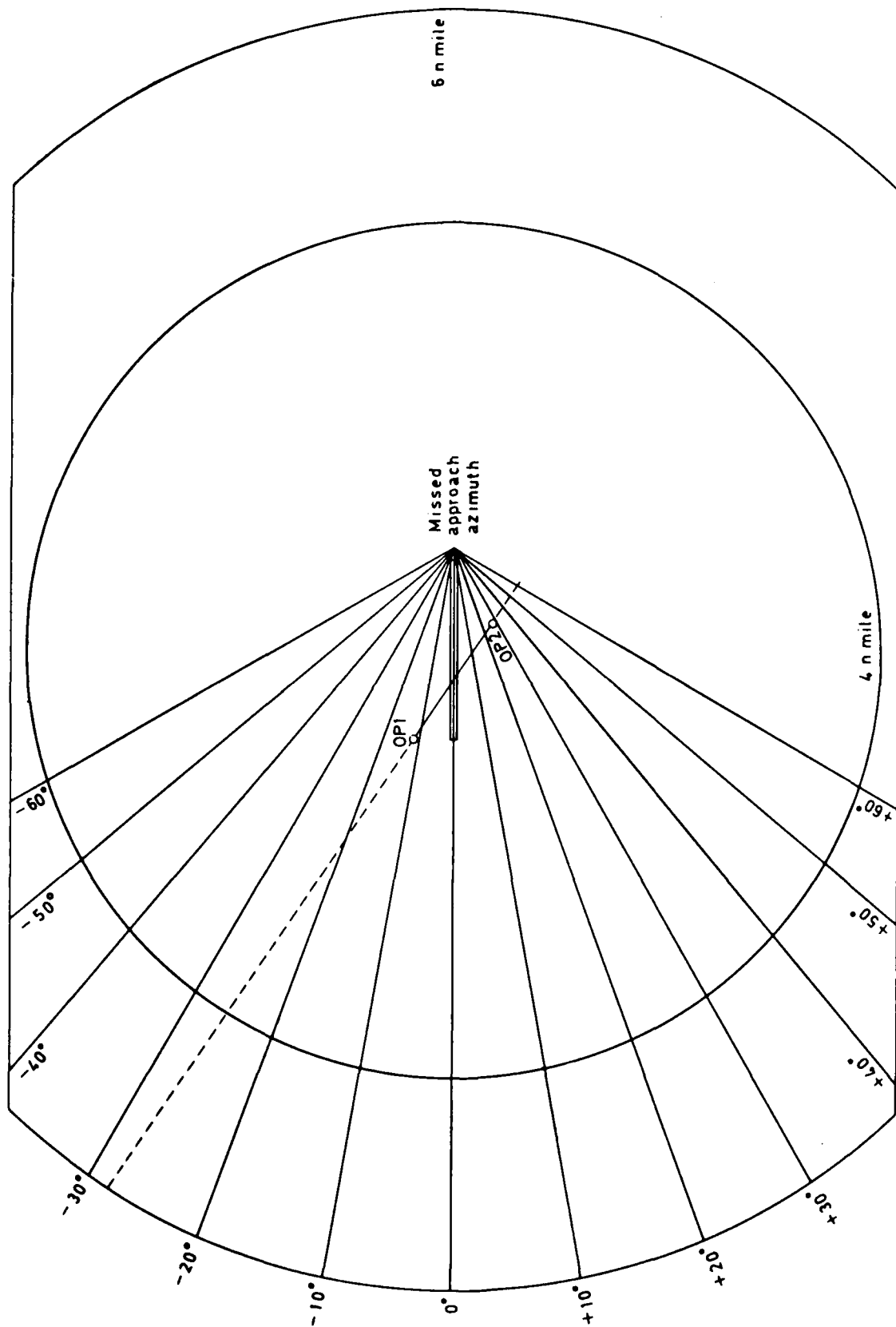


Fig 4.16b Kine base line in relation to missed approach azimuth flight paths

Fig 4.16c

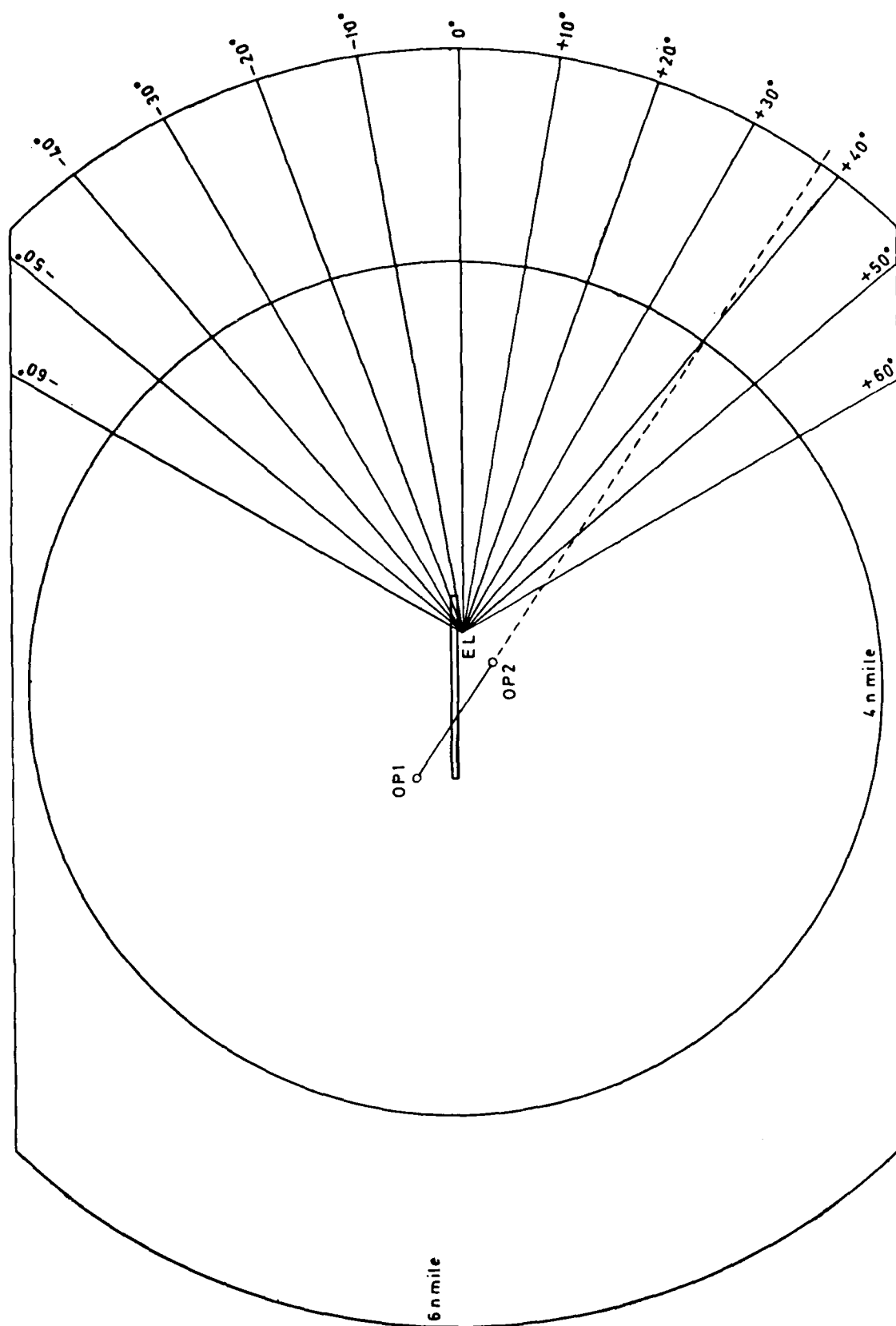


Fig 4.16c Kine base line in relation to elevation flight paths

Fig 4.17

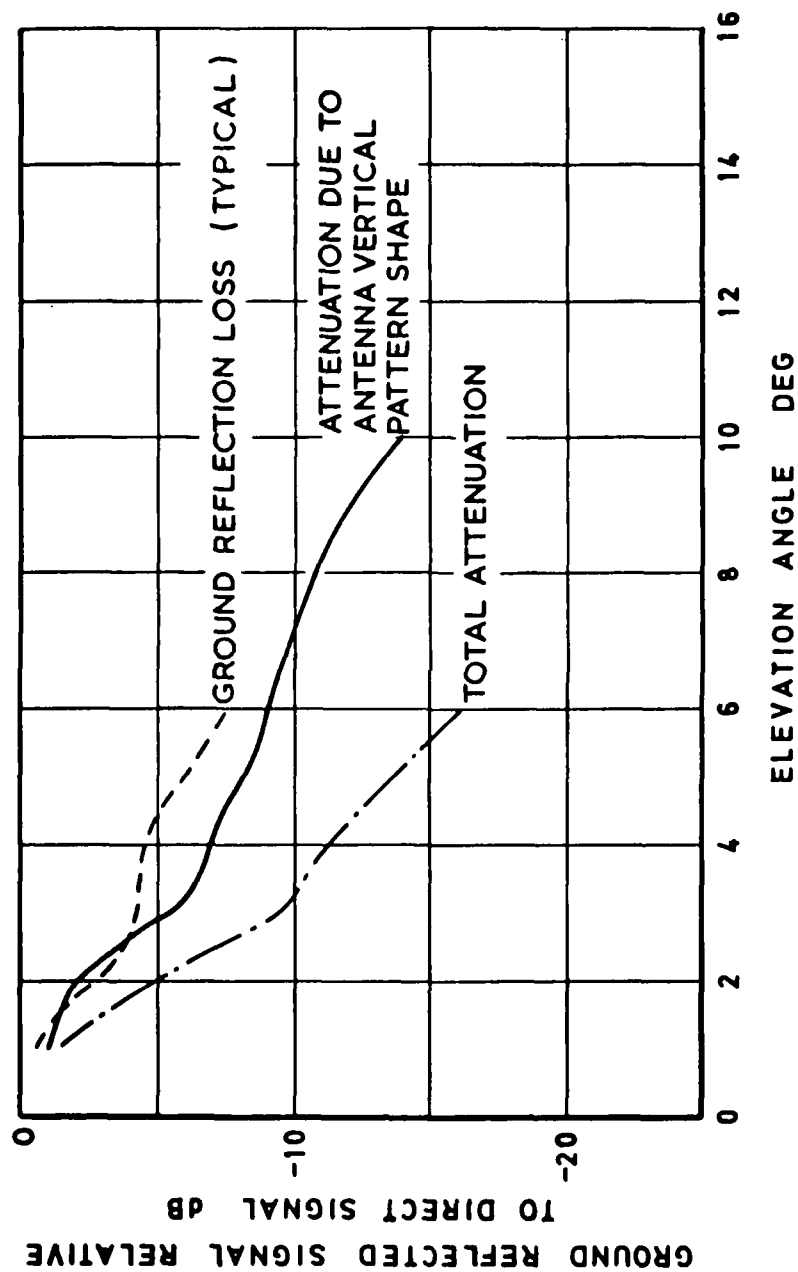


Fig 4.17 Estimated ground reflected signal for azimuth ground plane antenna

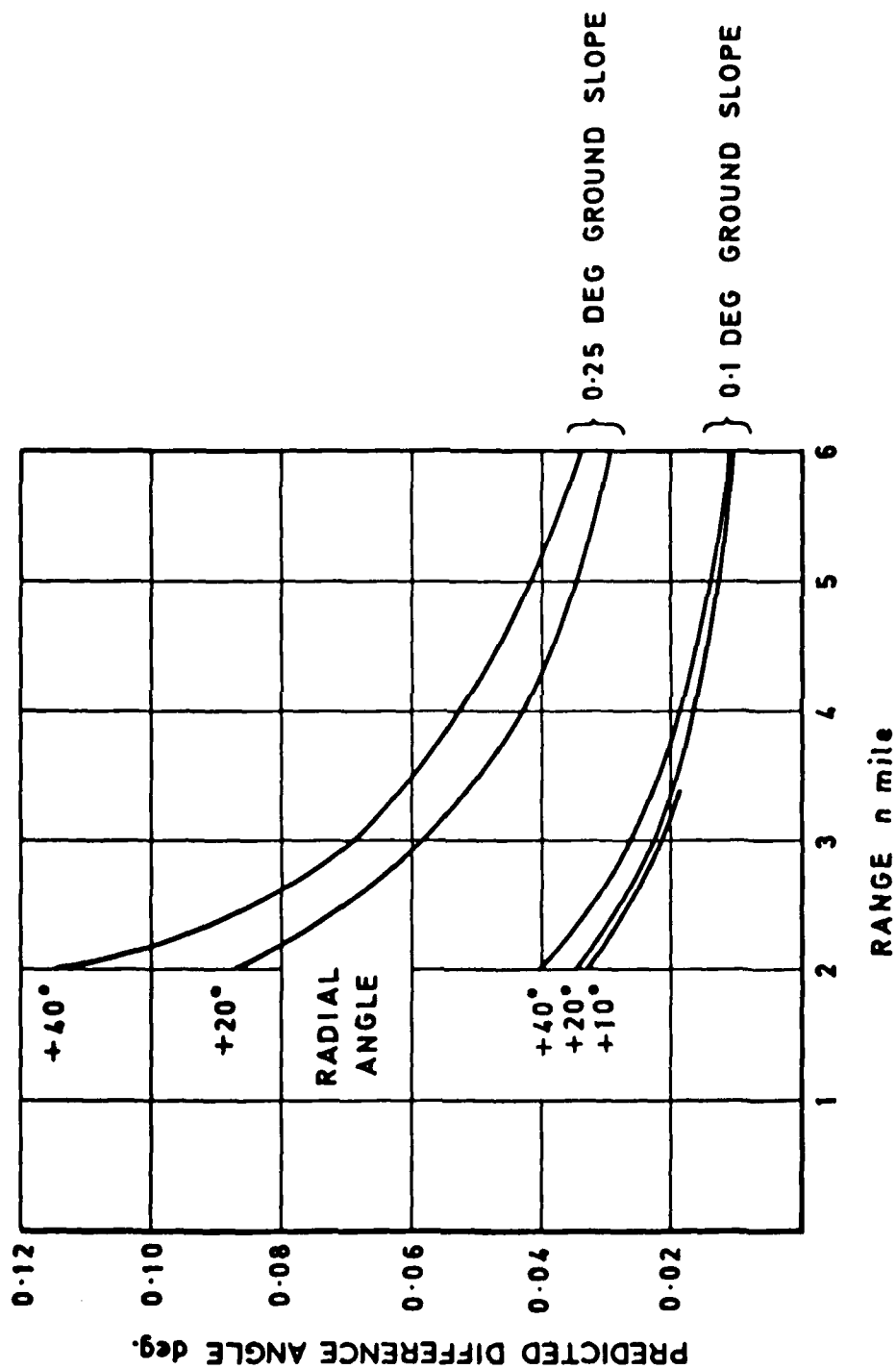


Fig 4.18 Predicted code angle difference between direct and ground reflected signal for 0.1 and 0.25 degree lateral slope during 2000 ft constant height radials

Fig 4.19

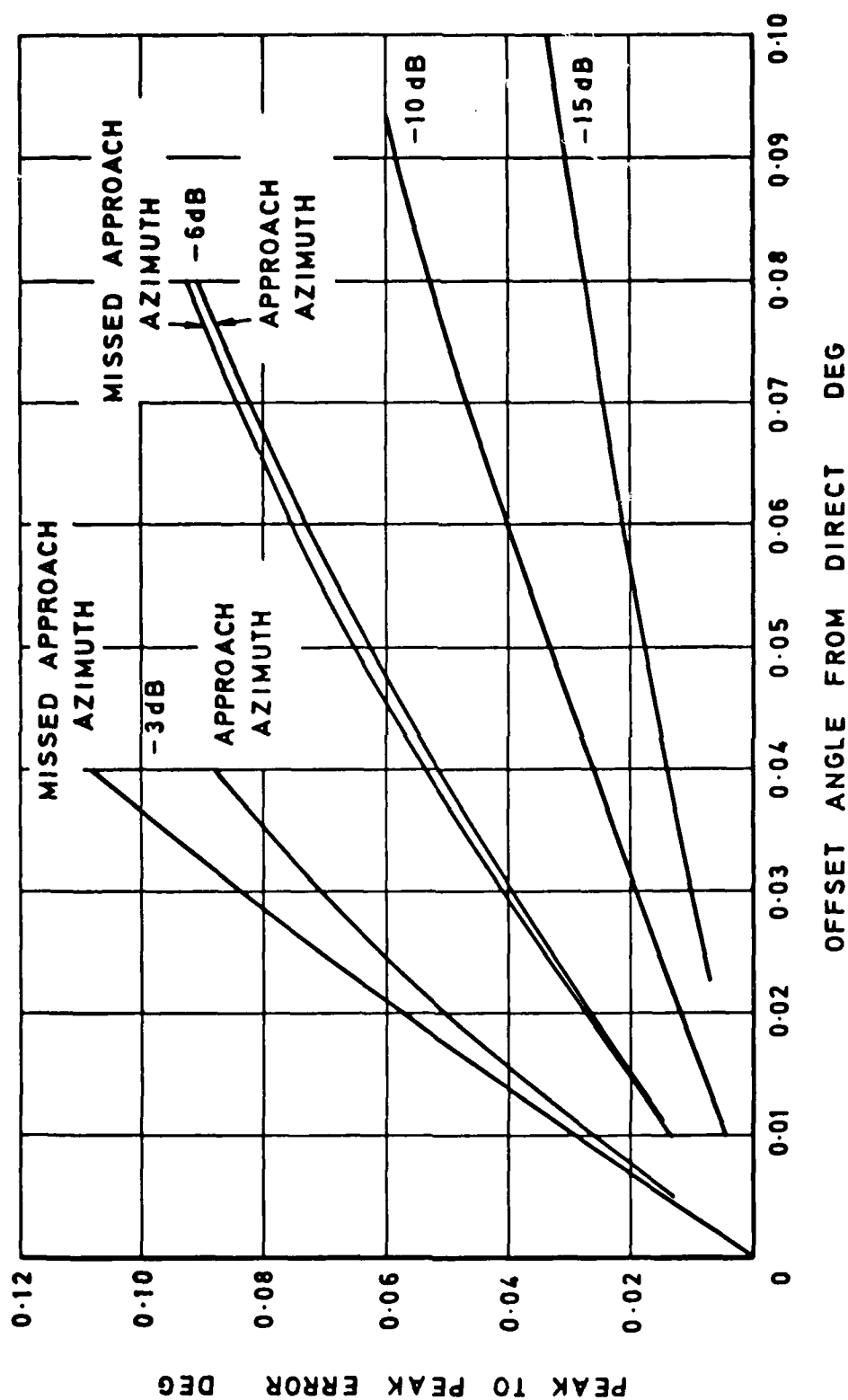


Fig 4.19 Calculated peak to peak error as a function of offset angle between direct and interfering signal

Fig 4.20

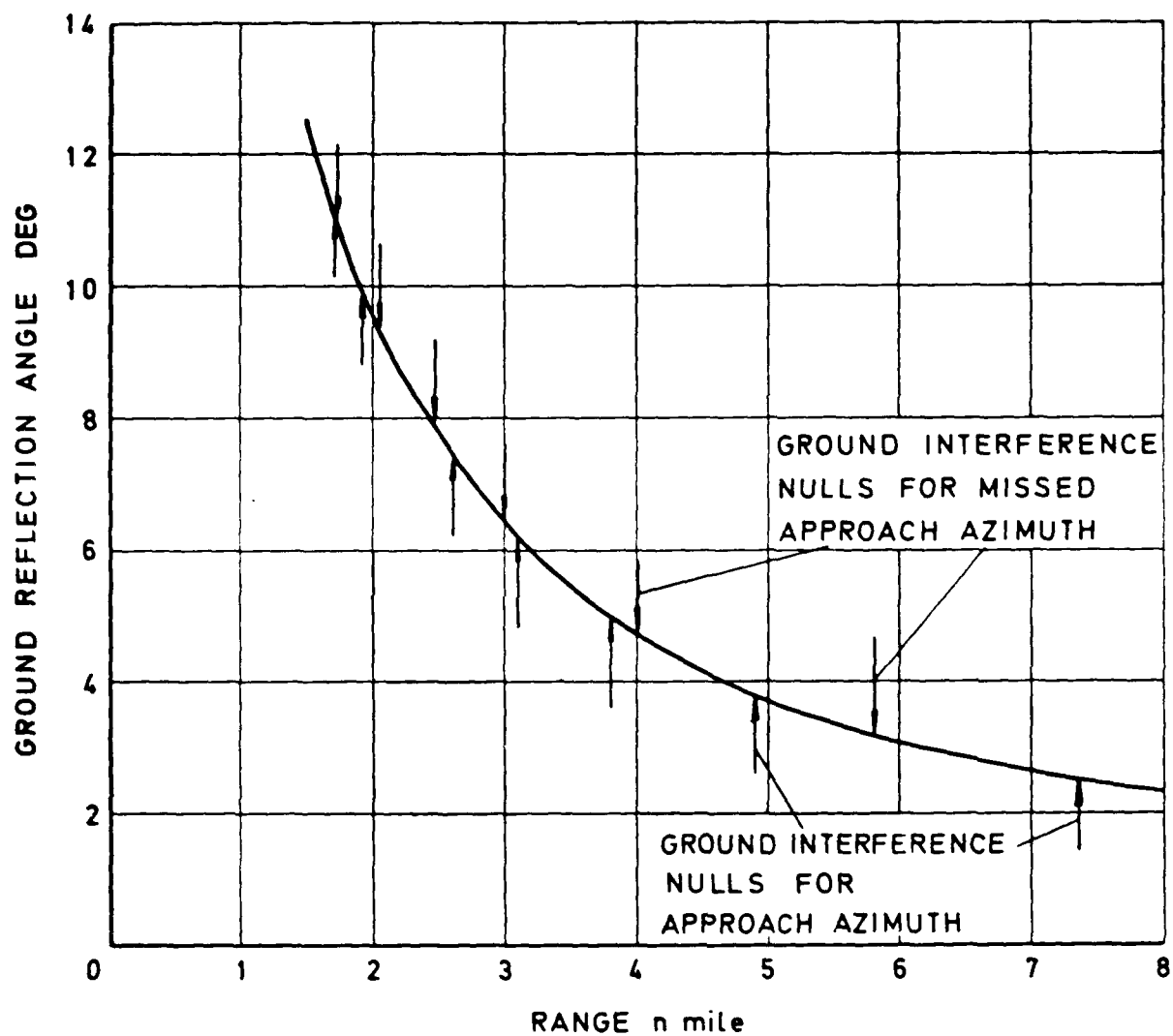


Fig 4.20 Elevation angle and ground interference nulls for 2000 ft constant height radials

Fig 4.21a

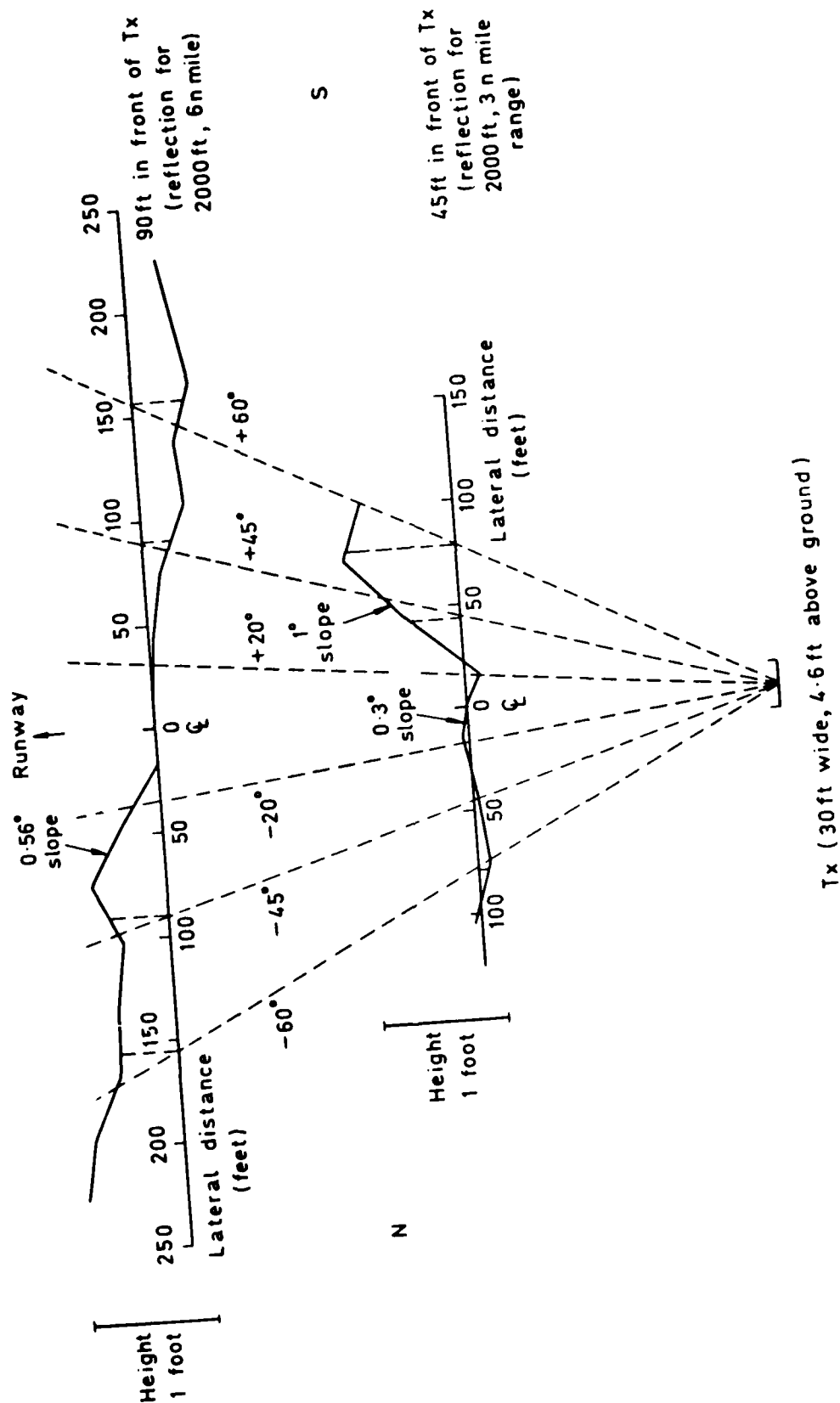


Fig 4.21a Lateral ground slope in front of approach azimuth transmitter

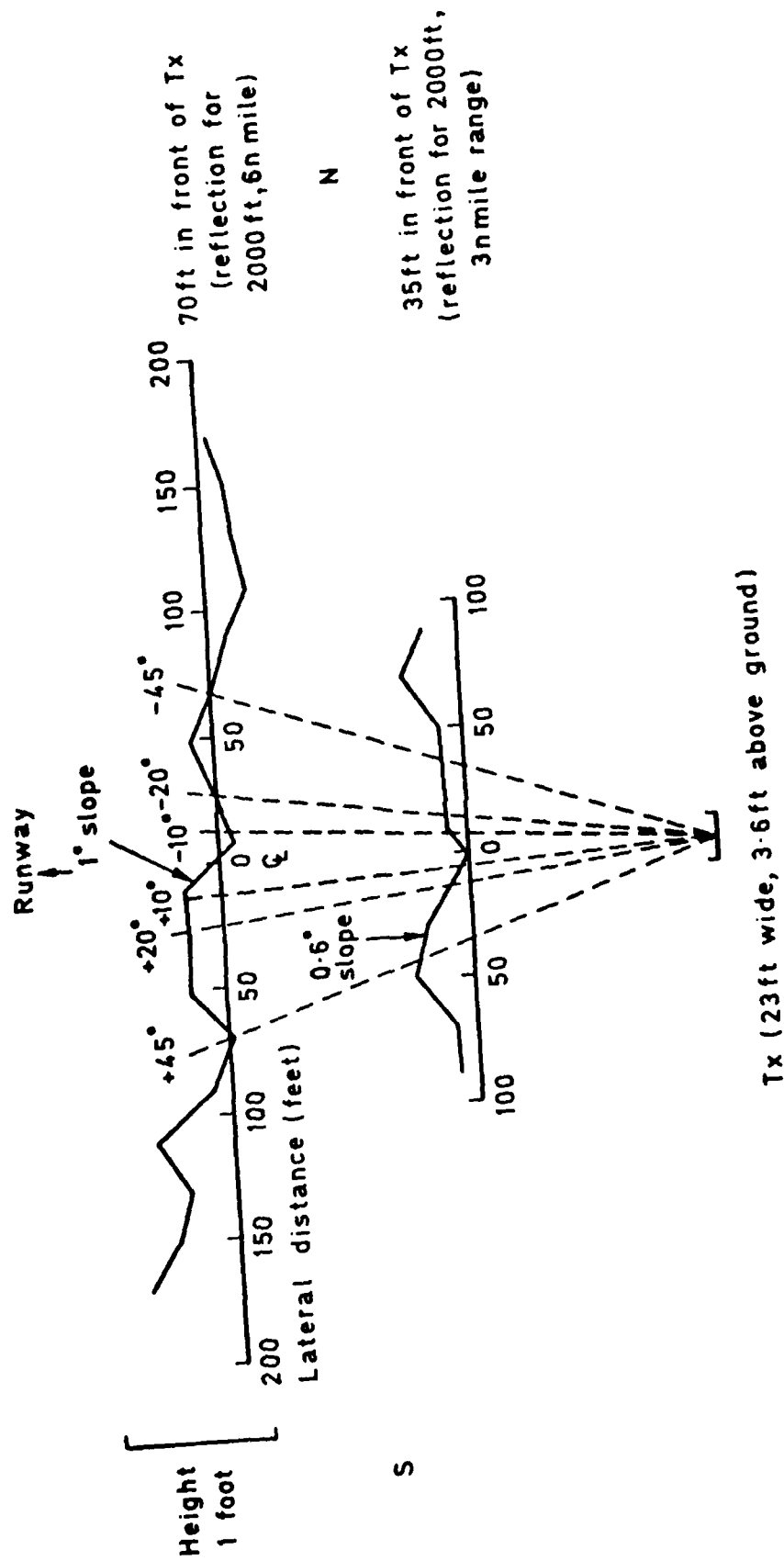
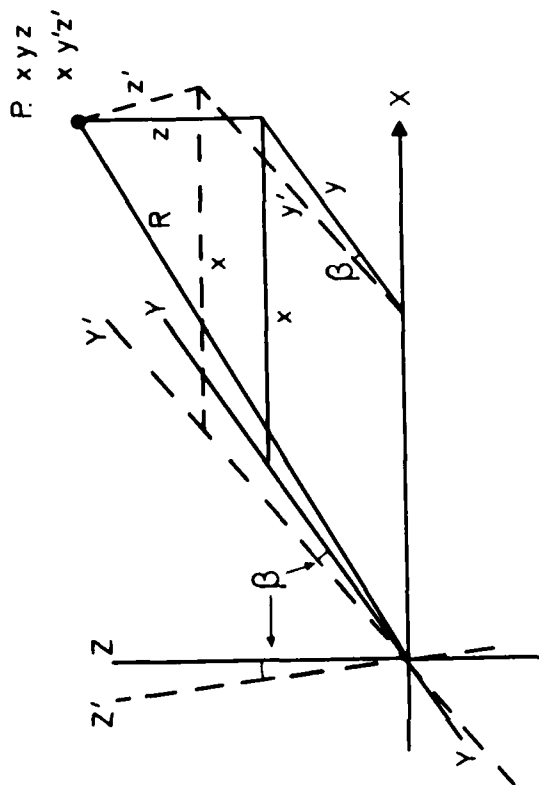


Fig 4.21b

Fig 4.21b Lateral ground slope in front of missed approach azimuth transmitter

Fig 4.22



True azimuth code angle = ϕ

$$\cos \phi = \frac{y}{R}$$

Tilted array axis is $Y'Y'$

Array code angle = ϕ'

$$\cos \phi' = \frac{y'}{R} = \frac{1}{R} \left[\frac{y}{\cos \beta} + (Z - y \tan \beta) \sin \beta \right]$$

$$= \frac{1}{R} \left[Z \sin \beta + y \left(\frac{1 - \sin^2 \beta}{\cos \beta} \right) \right]$$

$$= \frac{1}{R} (Z \sin \beta + y \cos \beta)$$

$$= \sin \theta \sin \beta + \cos \phi \cos \beta$$

Fig 4.22 Azimuth antenna tilt errors

TR 79052

DMLSFD-AR32/ 3-FRZSN-PAS/2-30/09/75

OFFSET = -40.01Z DEG

AA 32/3 30/9/75

H = 2250 FT

V = 123 KT

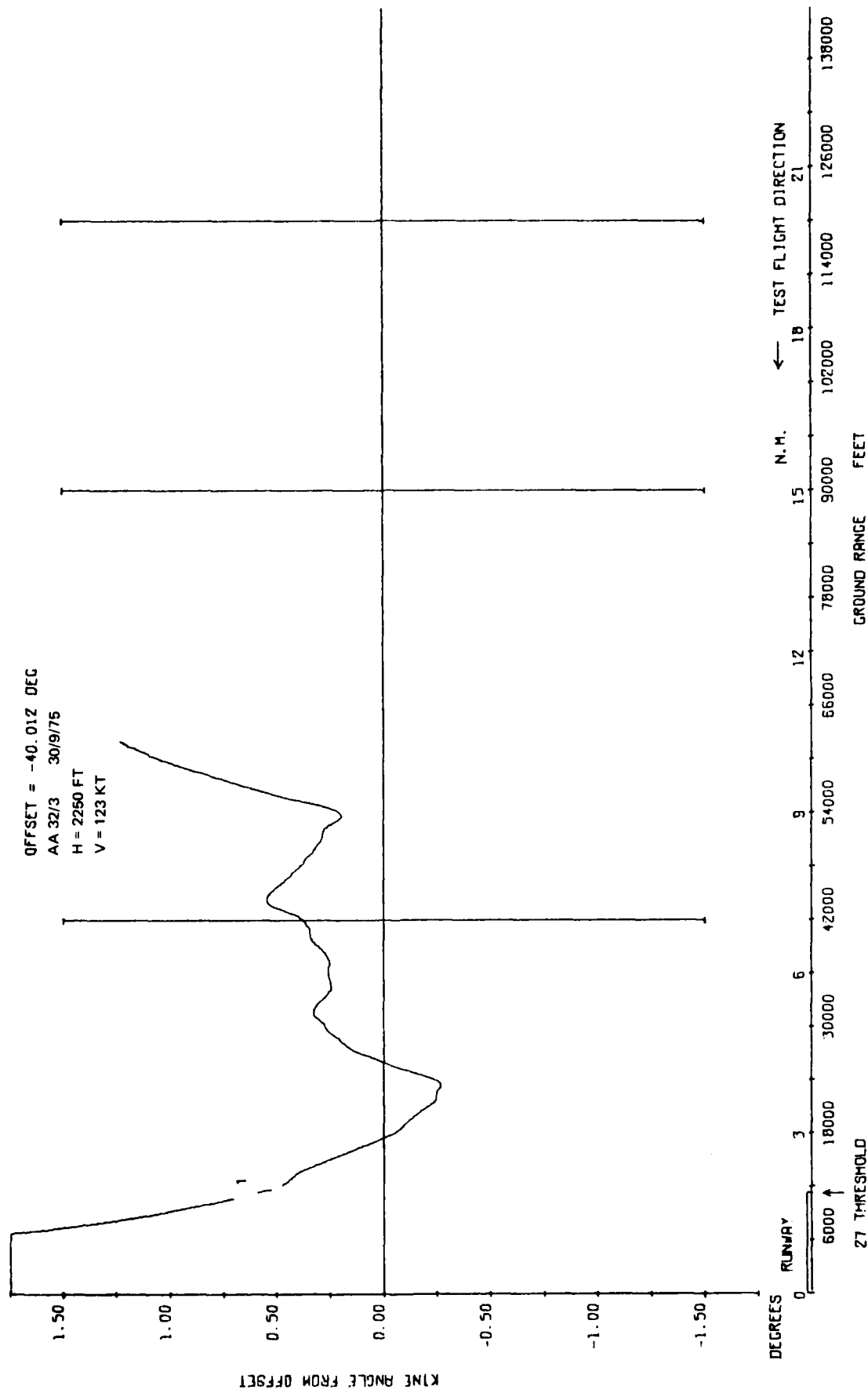


Fig 4.23a

Fig 4.23a Approach azimuth radial at -40 degrees

Fig 4.23c

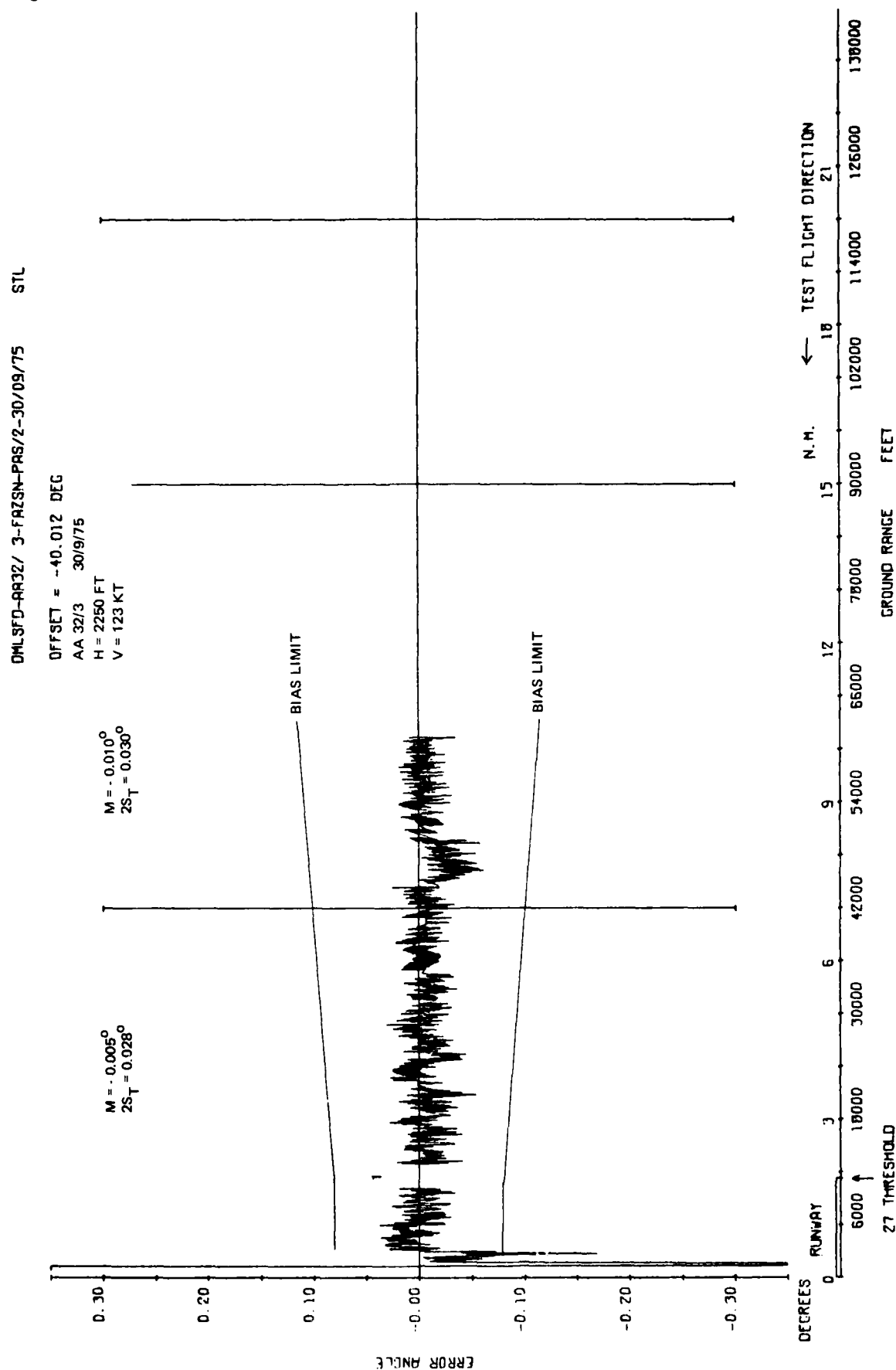


Fig 4.23c Approach azimuth radial at -40 degrees

DWLSFD-AR37/ 6-FAZSN-P85/2-06/11/75 STL

OFFSET = -20.025 DEG

AA 37/6 6/11/75

H = 2890 FT

V = 143 KT

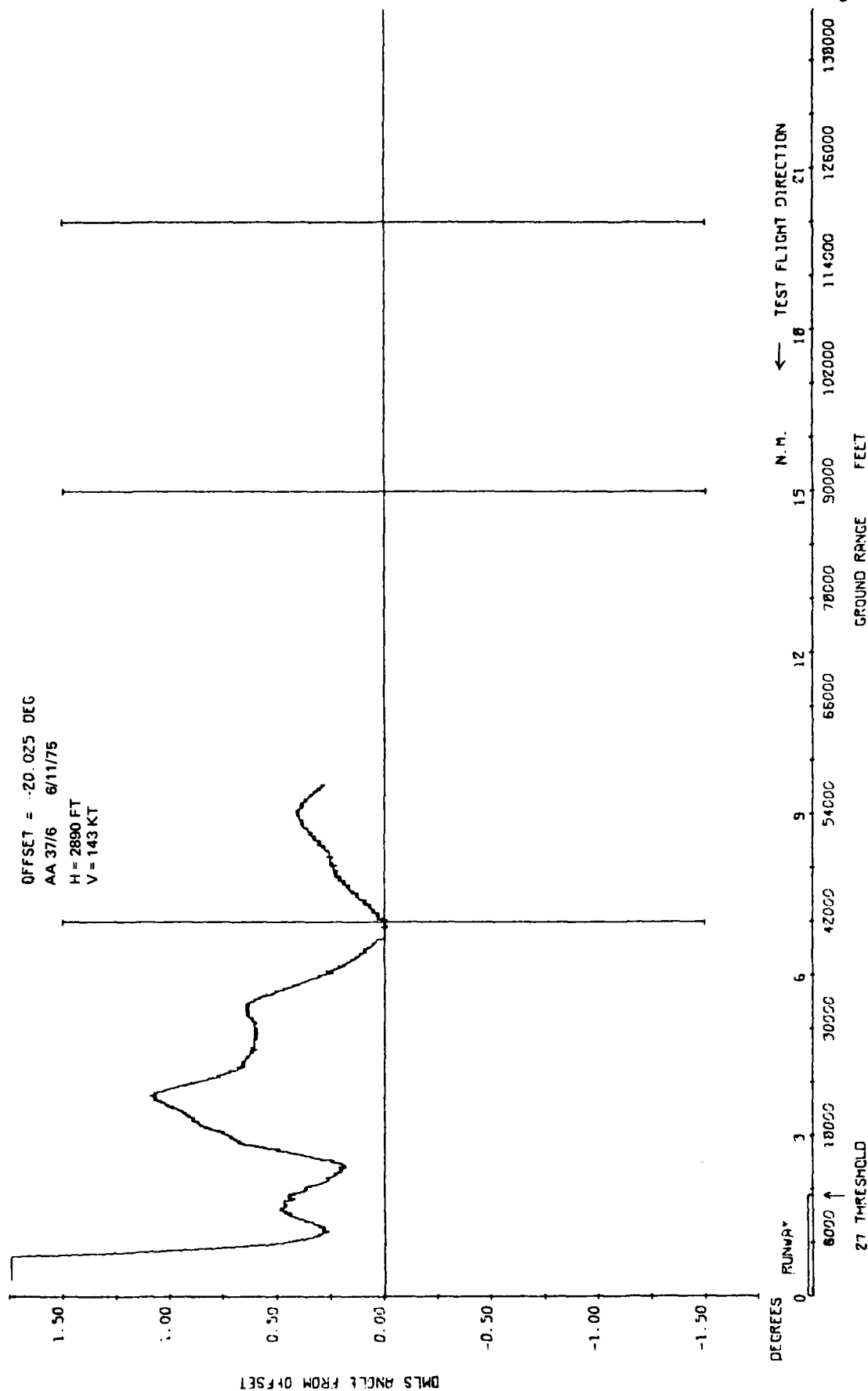


Fig 4.24b Approach azimuth radial at -20 degrees

Fig 4.24c

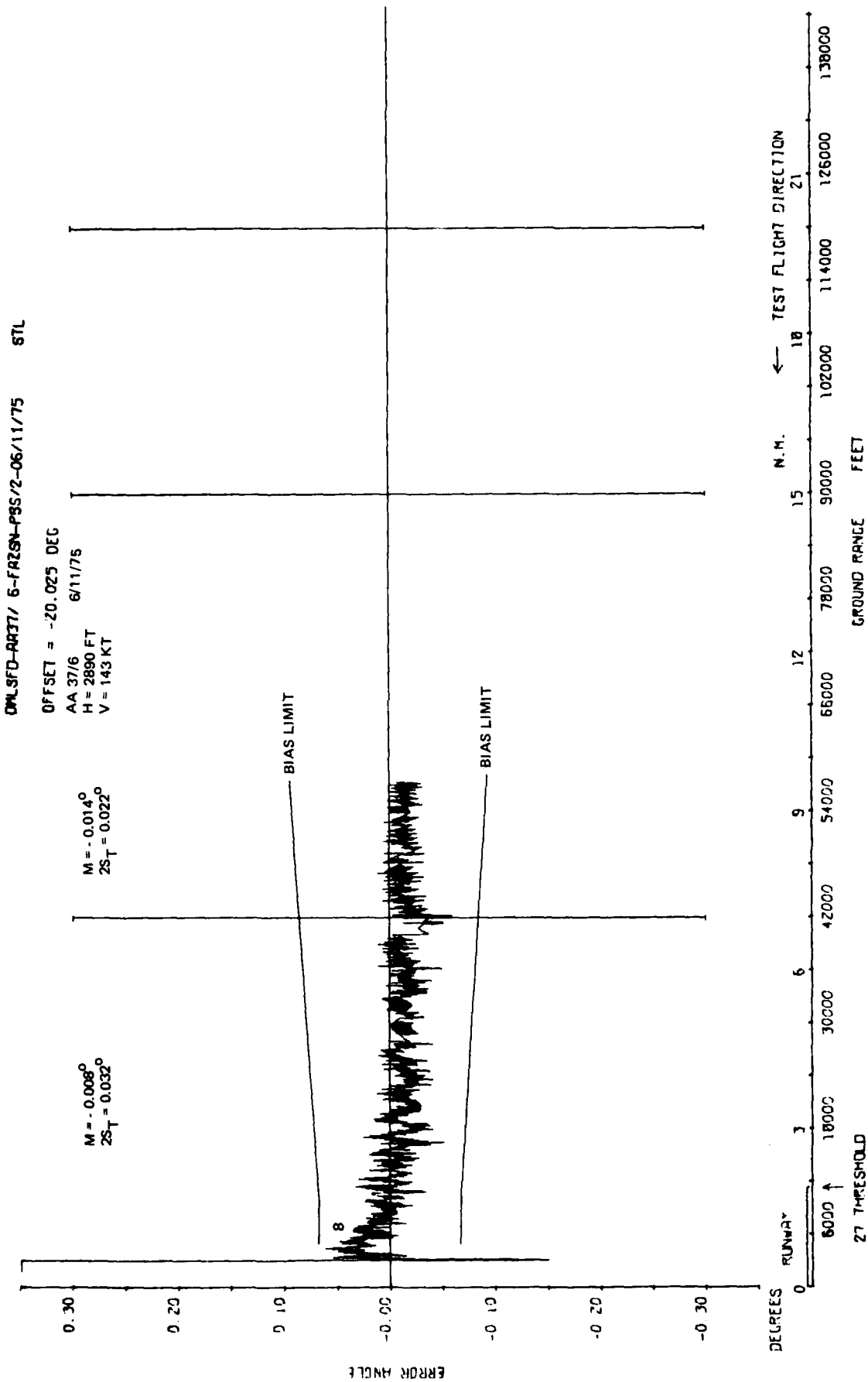


Fig 4.24c Approach azimuth radial at -20 degrees

TR 79052

OWLSFD-AB14/ 7-1RZSN-PDS/2-05/05/75

OFFSET = 0.000 DEG

AB14/7 5/5/75

H = 1520 FT

V = 204 KT

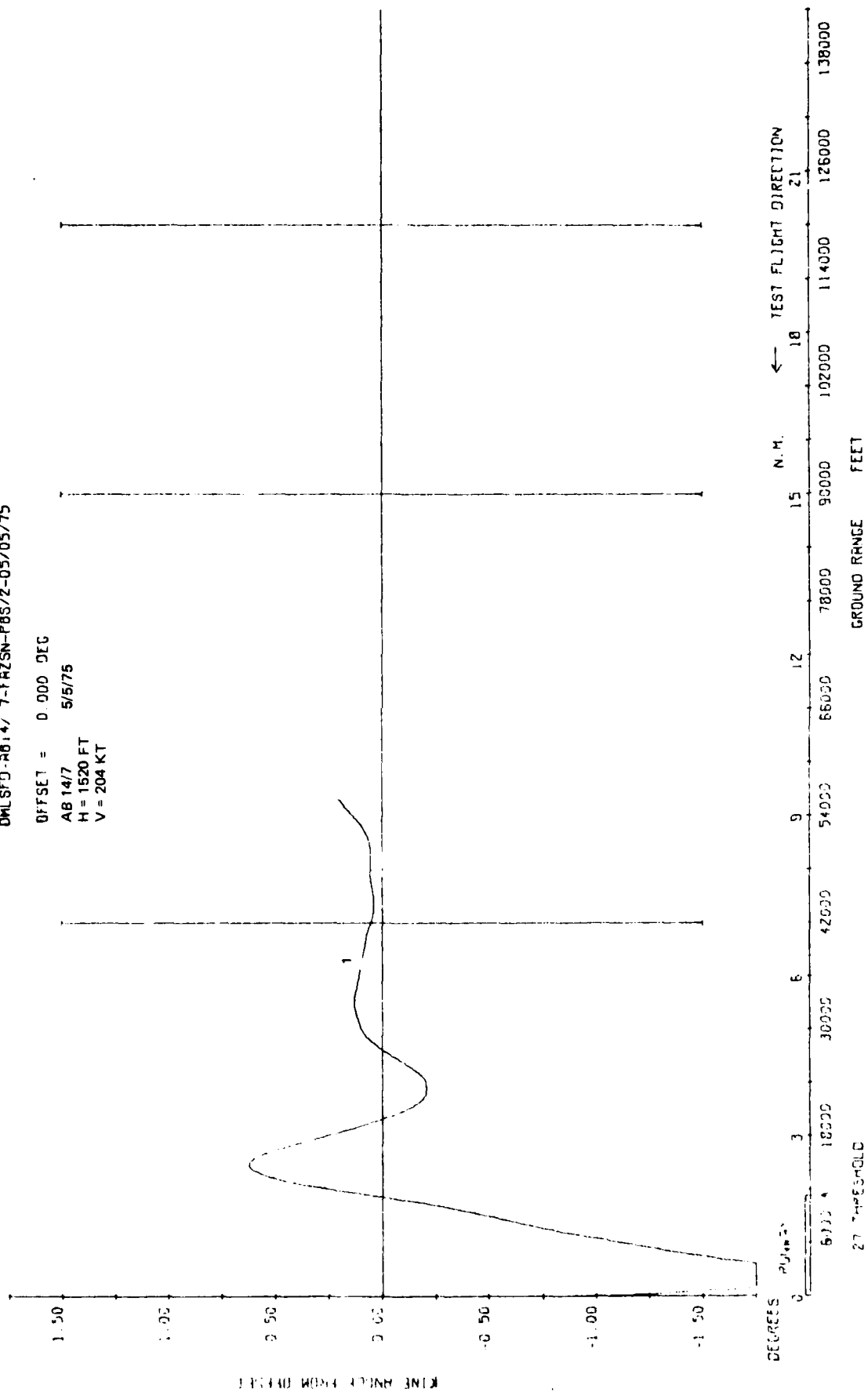


Fig 4.25a

Fig 4.25a Approach azimuth radial at 0 degree

OMLSFD-AB14/ 7-FRZSN-P8E/2-05/05/75 6TL

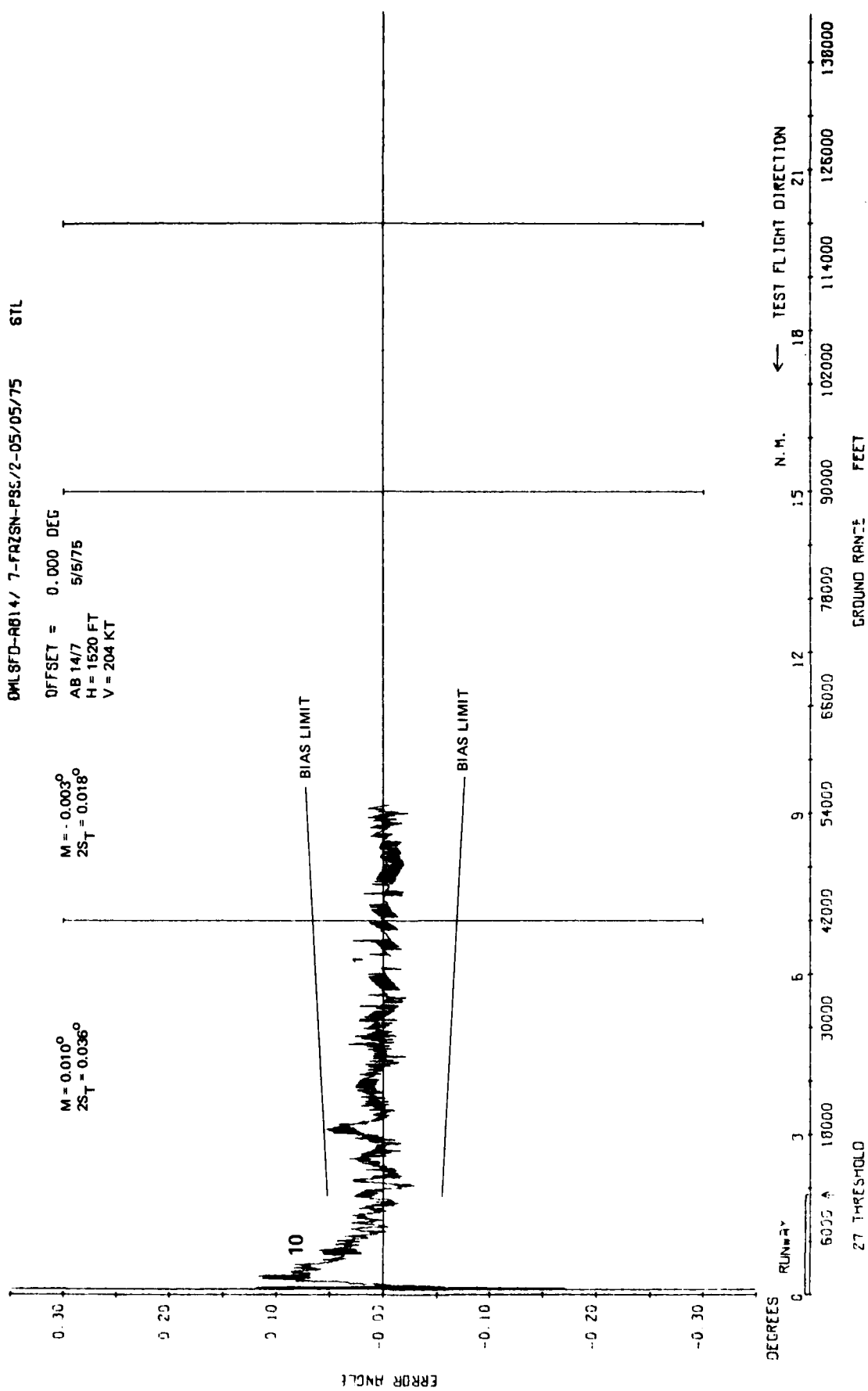


Fig 4.25c Approach azimuth radial at 0 degree

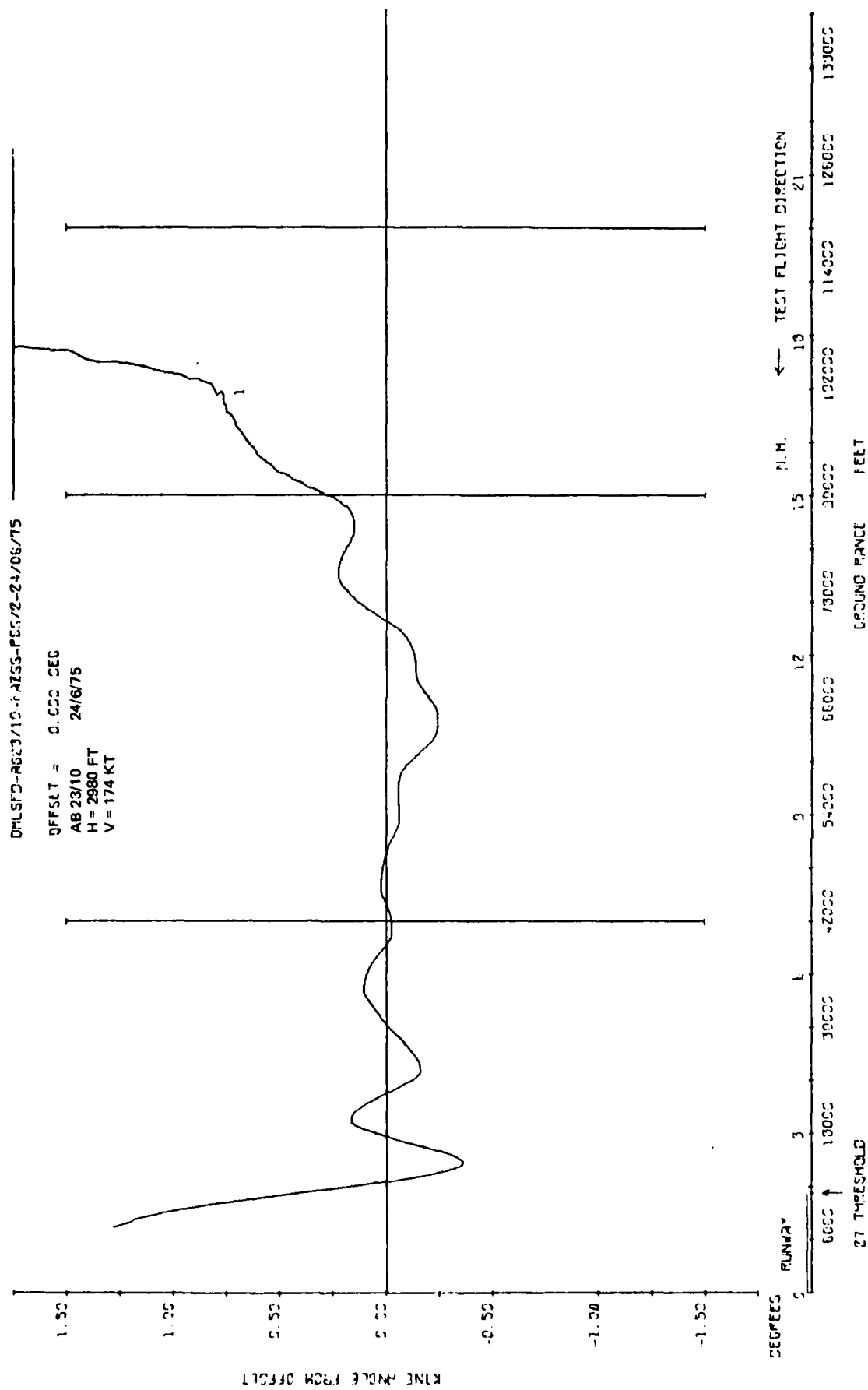


Fig 4.26a

Fig 4.26a Approach azimuth radial at 0 degree

Fig 4.26b

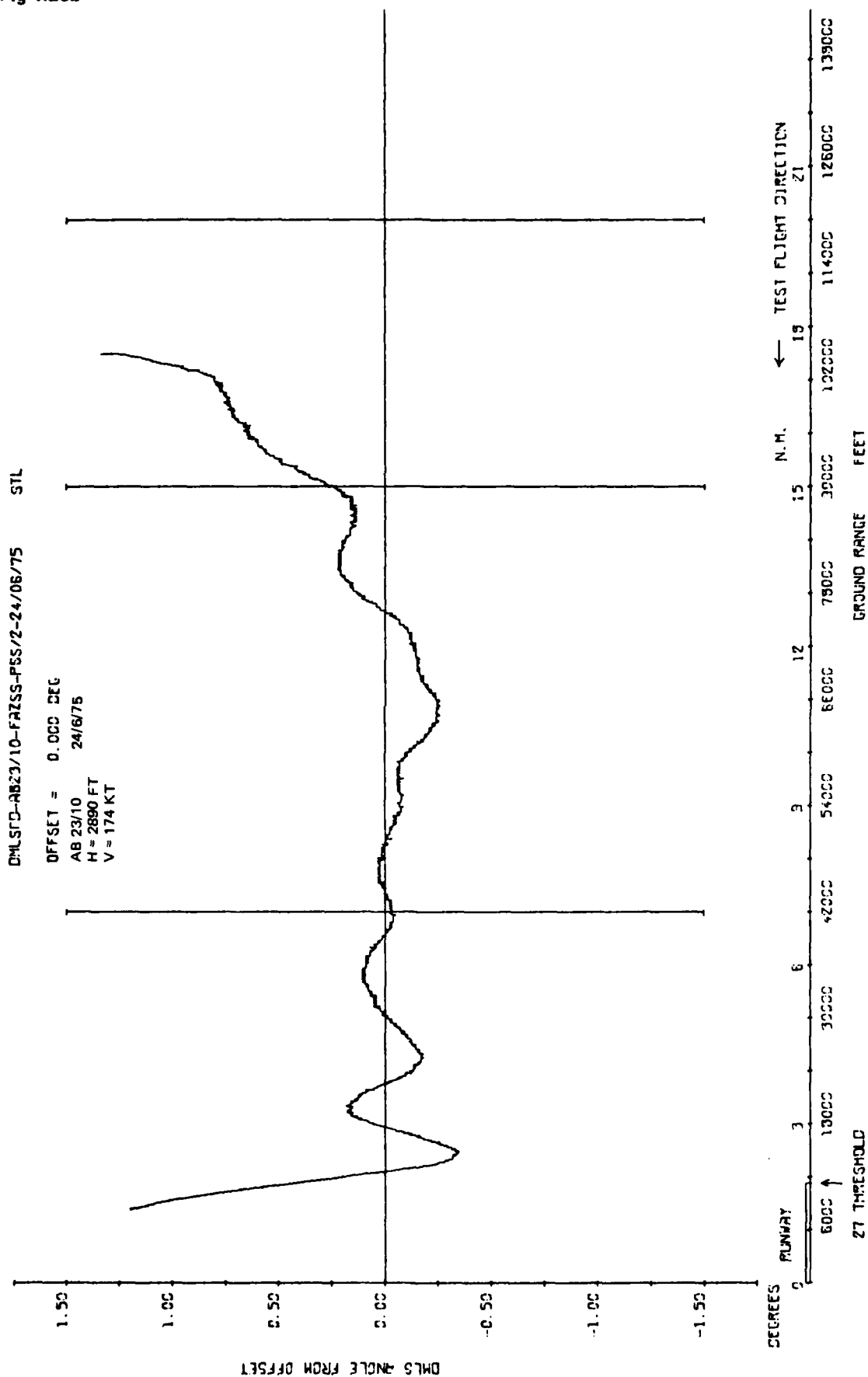


Fig 4.26b Approach azimuth radial at 0 degree

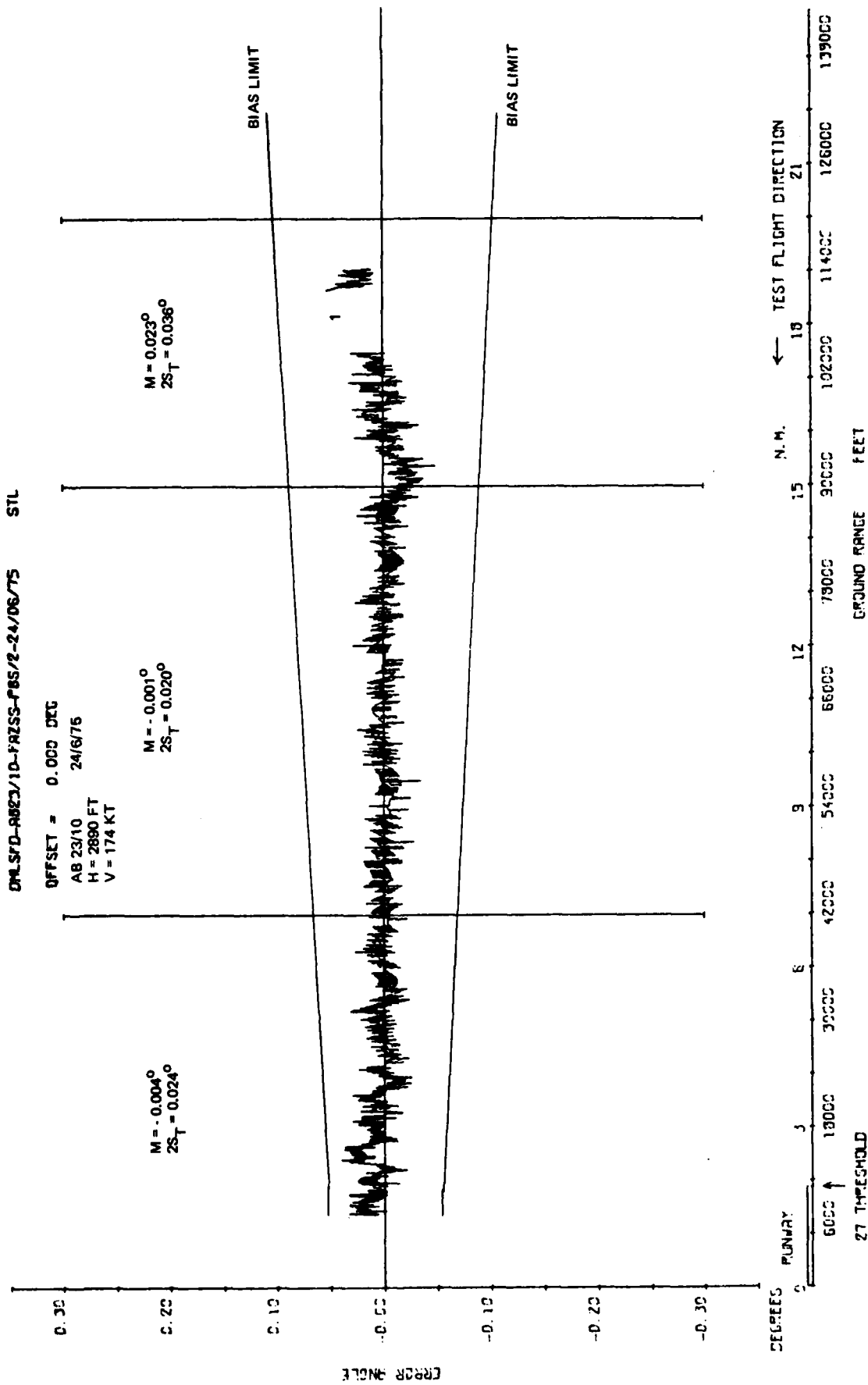


Fig 4.26c

Fig 4.26c Approach azimuth radial at 0 degree

H = 2820 FT
V = 128 KT

DMLSFD-RR37/ 7-FAZON-PBS/2-06/11/75
OFFSET = 13.996 DEG

KIN

TEST FLIGHT DIRECTION

N.M. FEET

RUNWAY
27 THRESHOLD

Fig 4.27a Approach azimuth radial at +20 degrees

TR 79062

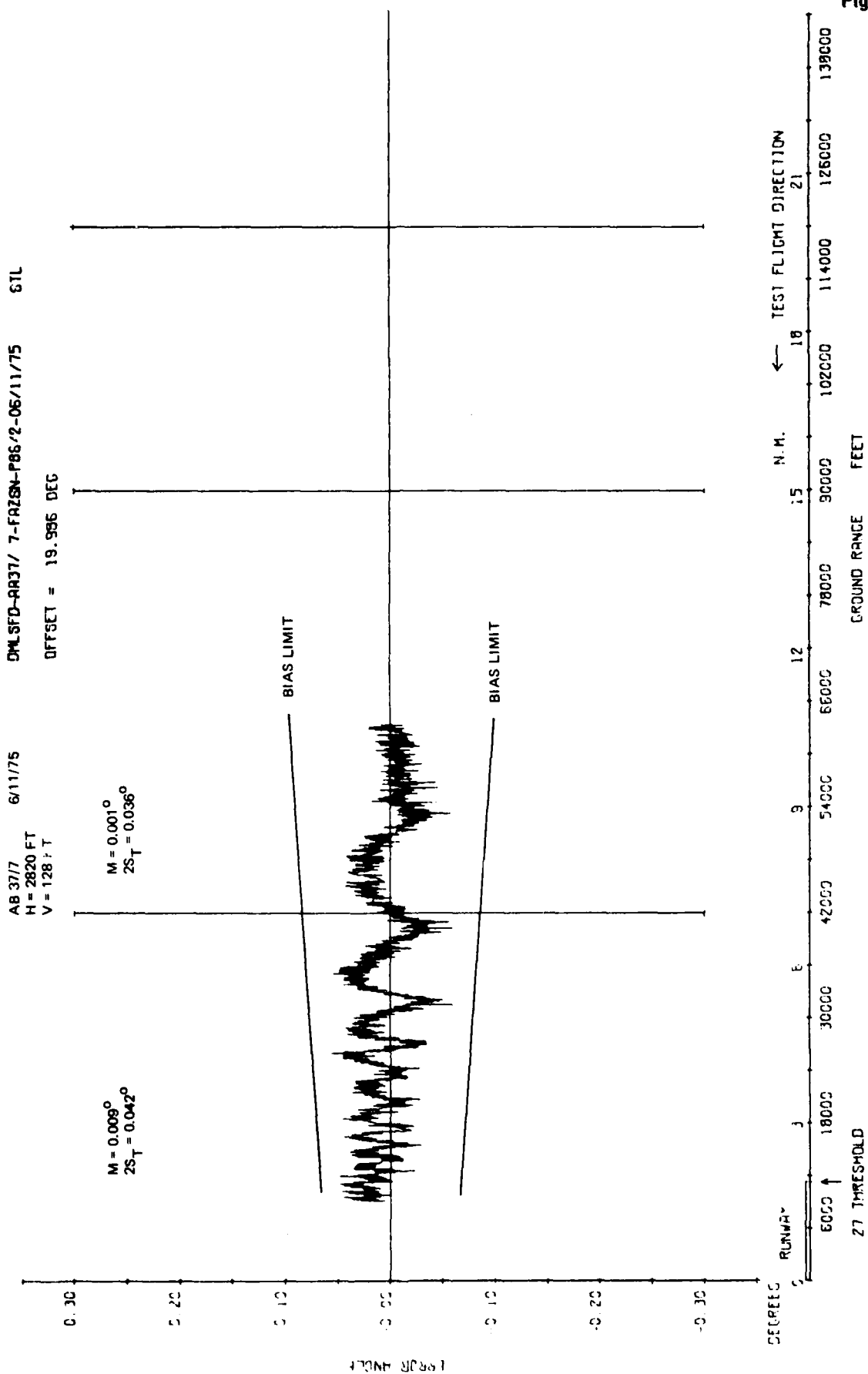


Fig 4.27c

Fig 4.27c Approach azimuth radial at +20 degrees

Fig 4.28b

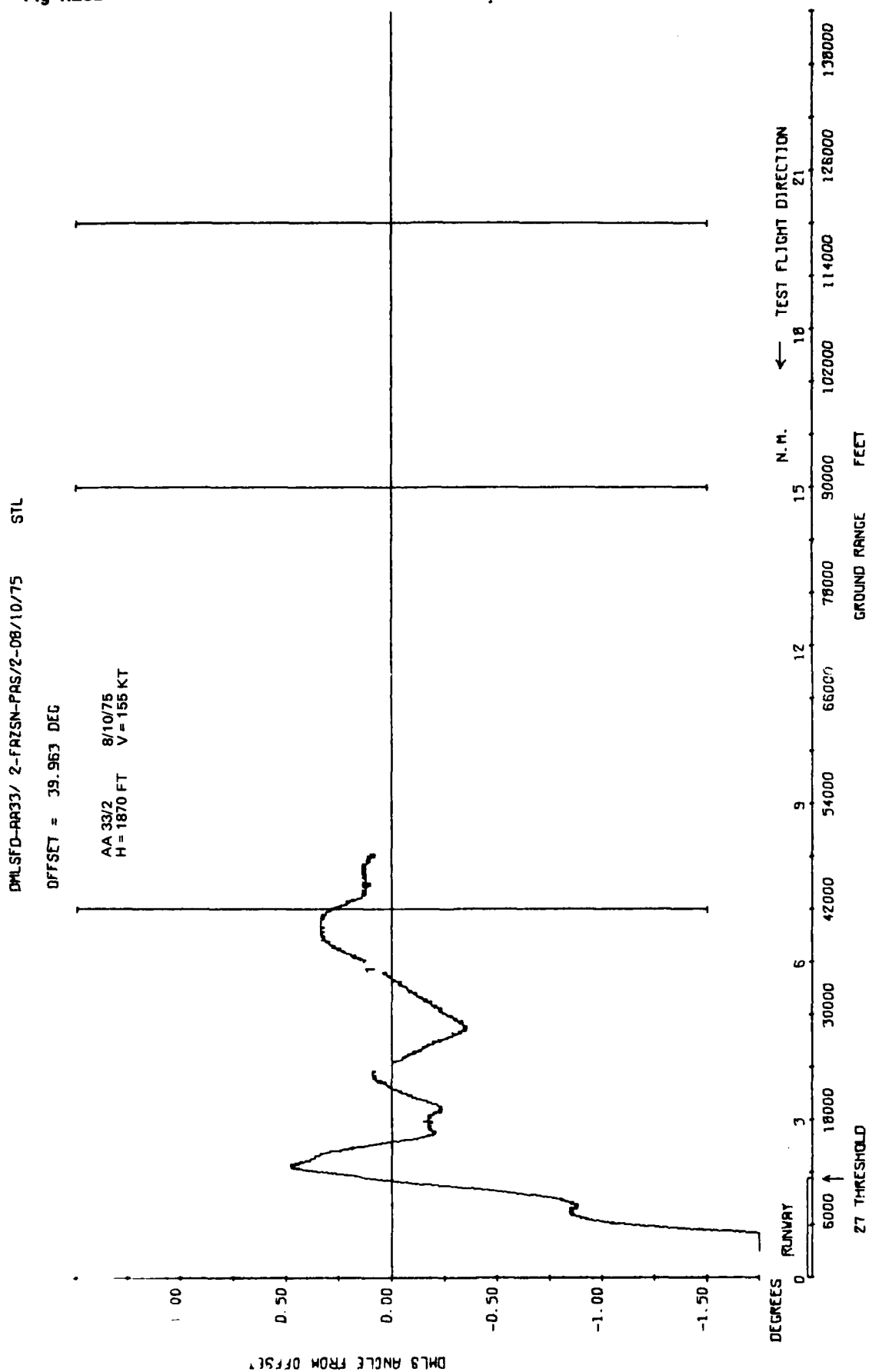


Fig 4.28b Approach azimuth radial at +40 degrees

TR 79052

DMLSTD-AR33, 2-FAZSN-PAS/2-08/10/75 STL

OFFSET = 39.963 DEG

AA 33/2 8/10/75

H = 1870 FT V = 155 KT

$M = 0.044^\circ$
 $2S_T = 0.022^\circ$

$M = 0.045^\circ$
 $2S_T = 0.046^\circ$

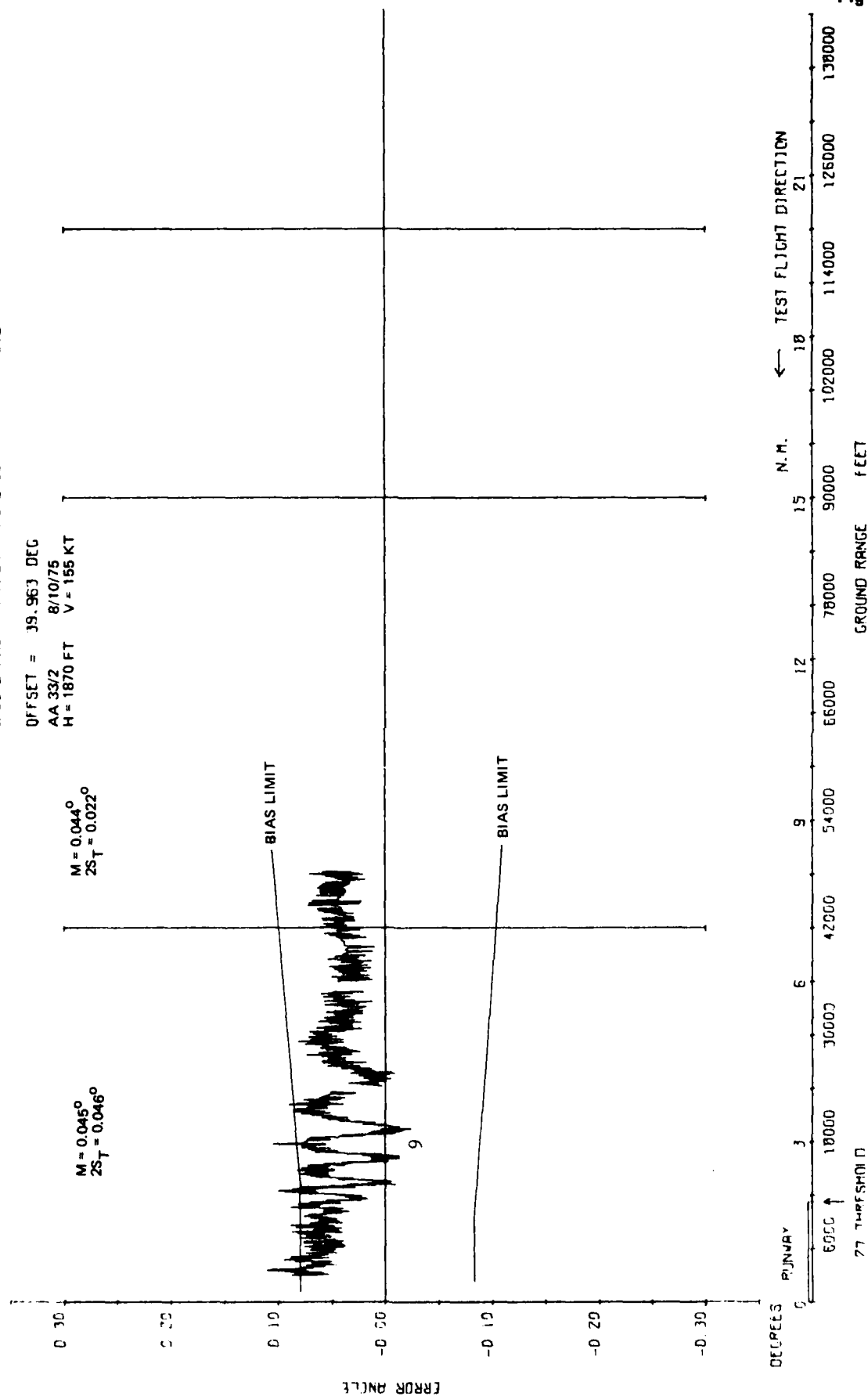


Fig 4.28c Approach azimuth radial at +40 degrees

Fig 4.29a/b

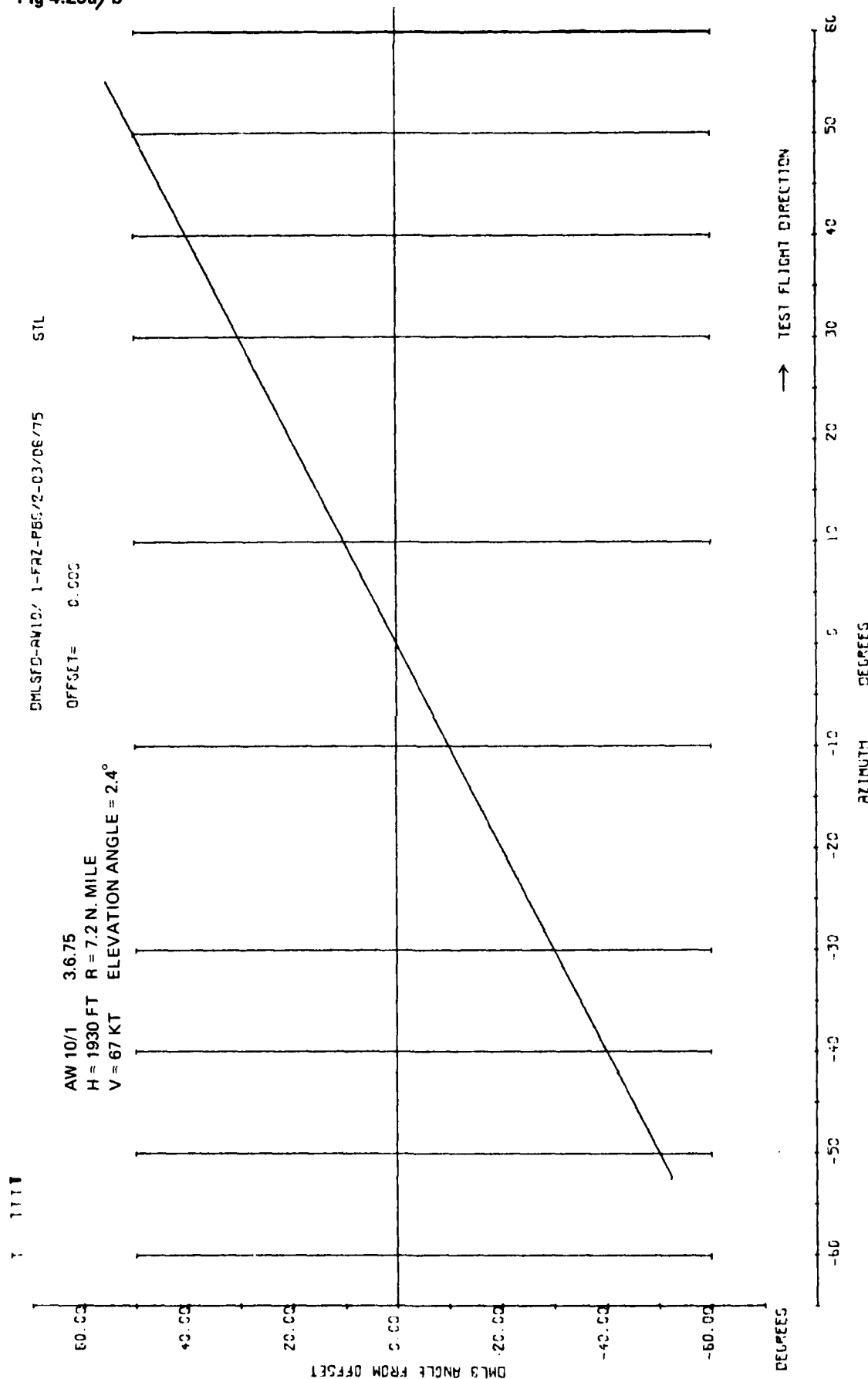


Fig 4.29a/b Approach azimuth orbital flight

$0.055 \times 1354.46 = 74.4993$

AW 10/1 3.6.75
H = 1930 FT R = 7.2 N. MILE
V = 67 KT ELEVATION ANGLE = 2.4°

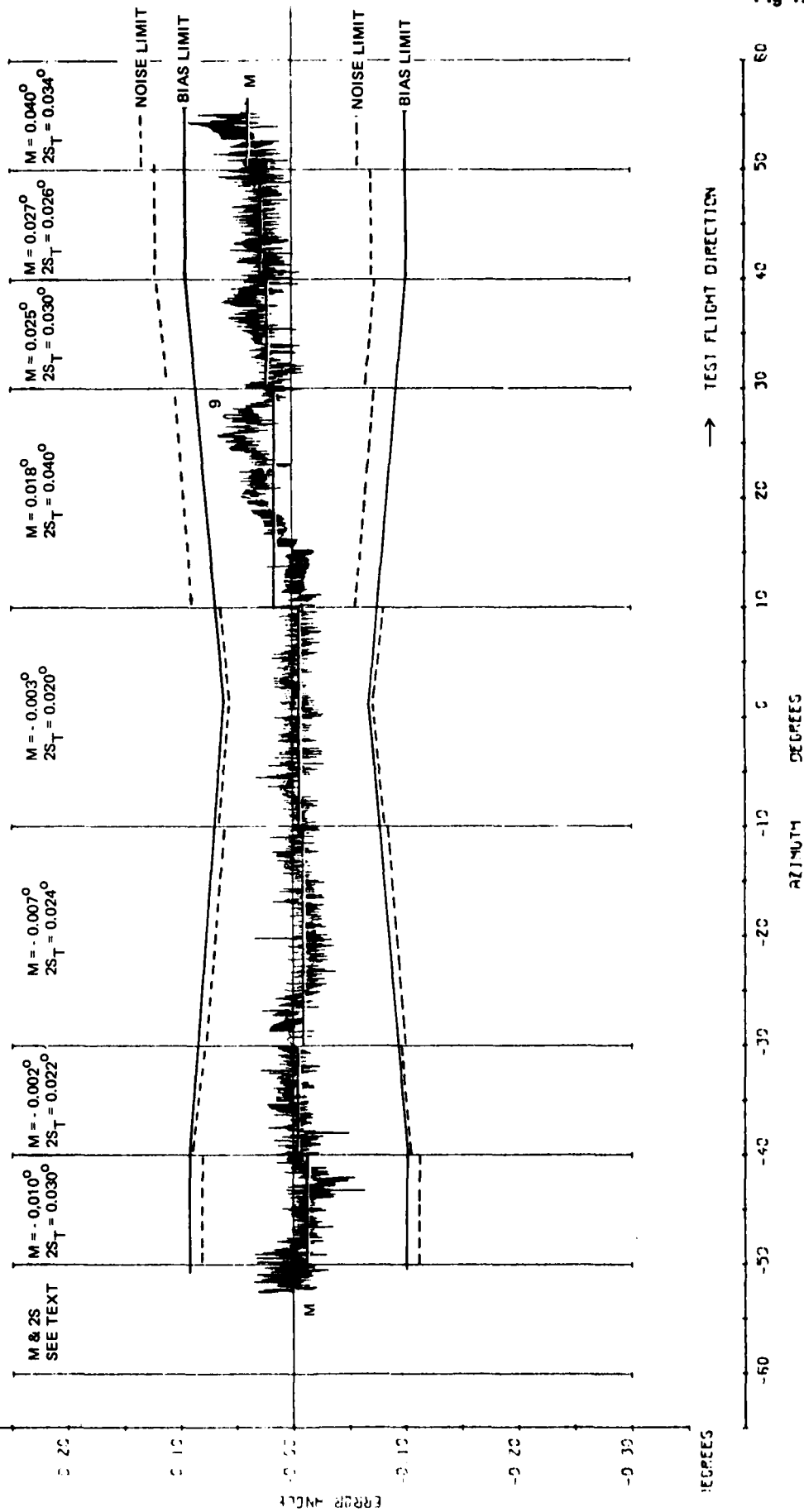


Fig 4.29c Approach azimuth orbital flight

Fig 4.29c

Fig 4.30c

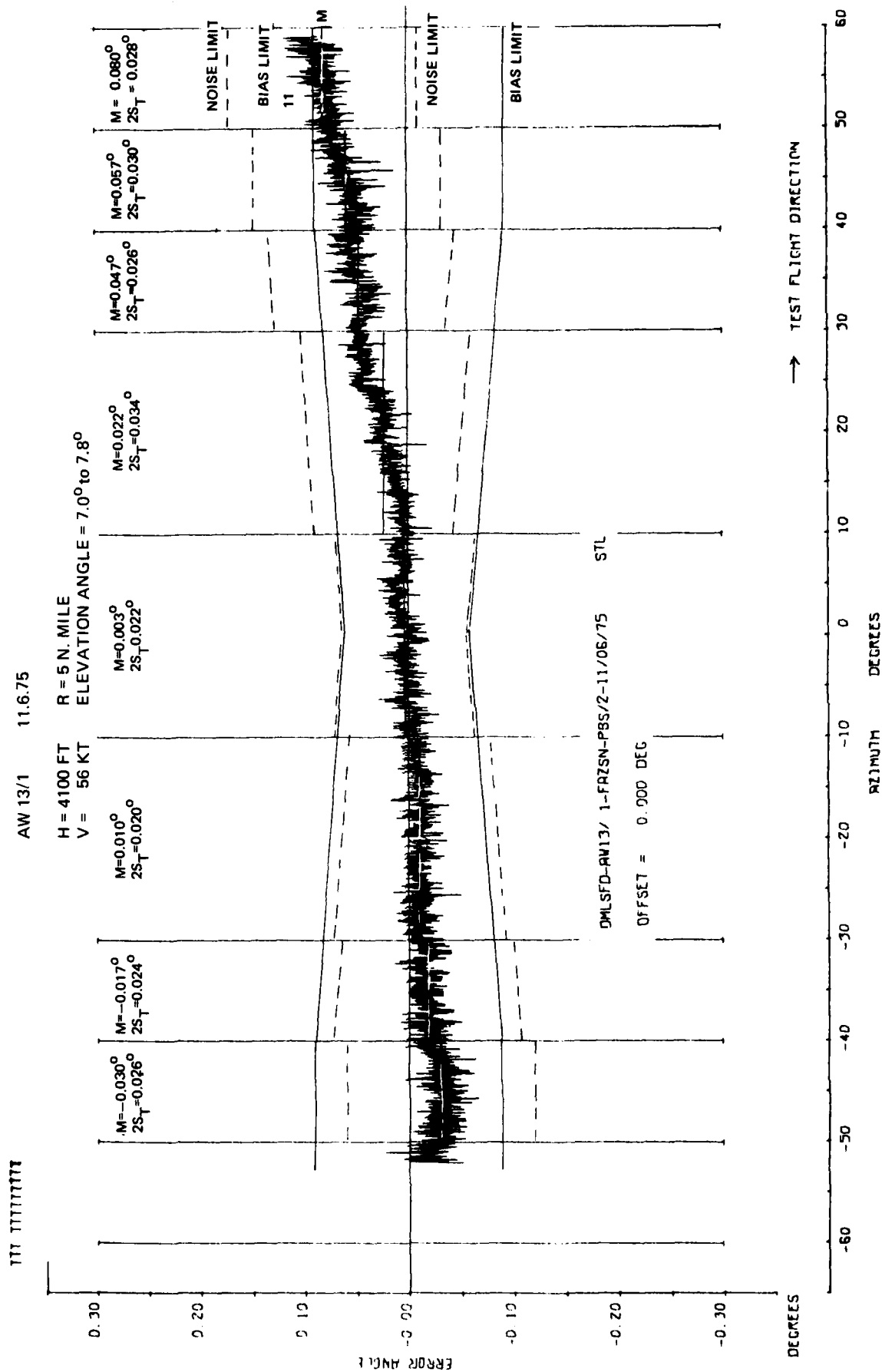


Fig 4.30c Approach azimuth orbital flight at 4100 ft. 5 n mile radius

CHLSE-RA33/ 3-FRIGN- S/2-22/12/75 STL
 AA39/3 22/12/75
 H = 1950 V = 156 KT

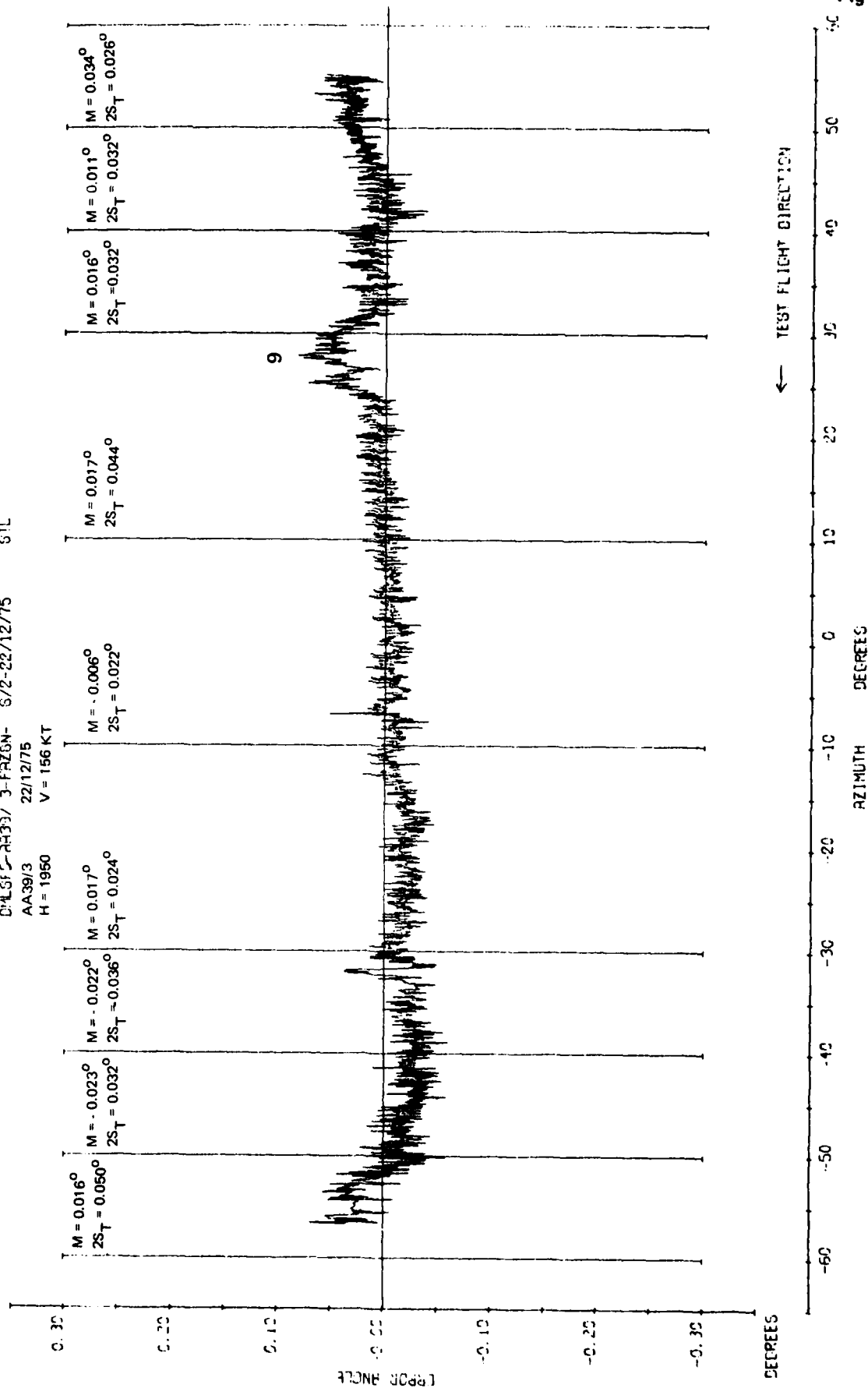


Fig 4.31c

Fig 4.31c Approach azimuth orbital flight at 1950 ft. 6 n mile radius

Fig 4.32a

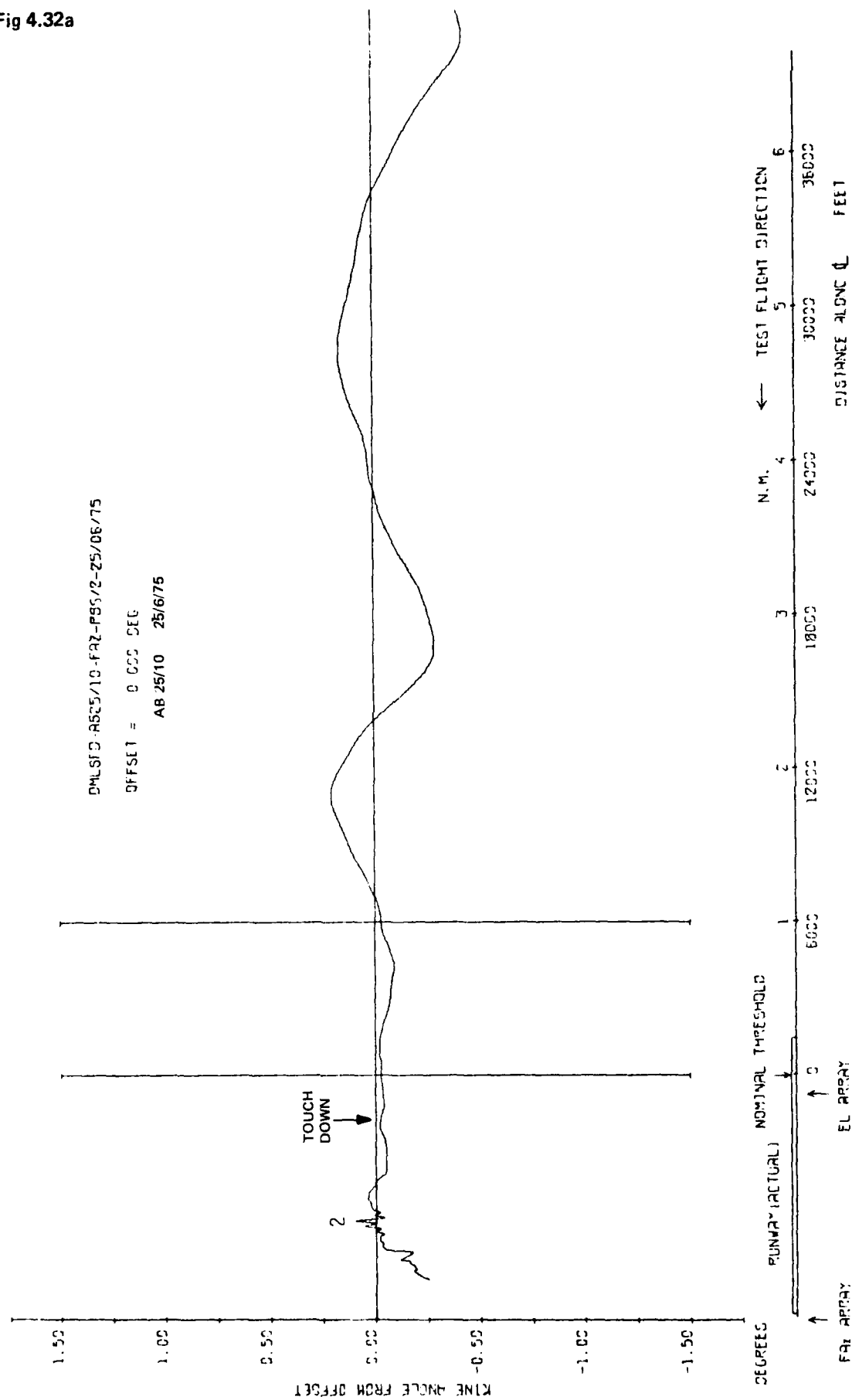


Fig 4.32a Approach azimuth accuracy. 3 degree approach to land and roll out

DHLSFD-AB25/10-FRZ-FBS/2-25/06/75 STL

OFFSET = 0.000 DEG

AB 25/10 25/6/75

$M = -0.005^\circ$
 $2S_T = 0.020^\circ$

$M = 0.003^\circ$
 $2S_T = 0.022^\circ$

$M = 0.005^\circ$

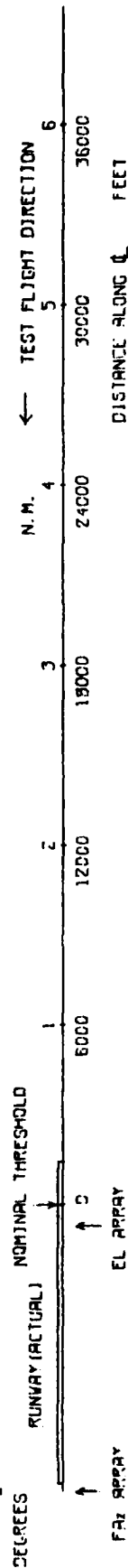
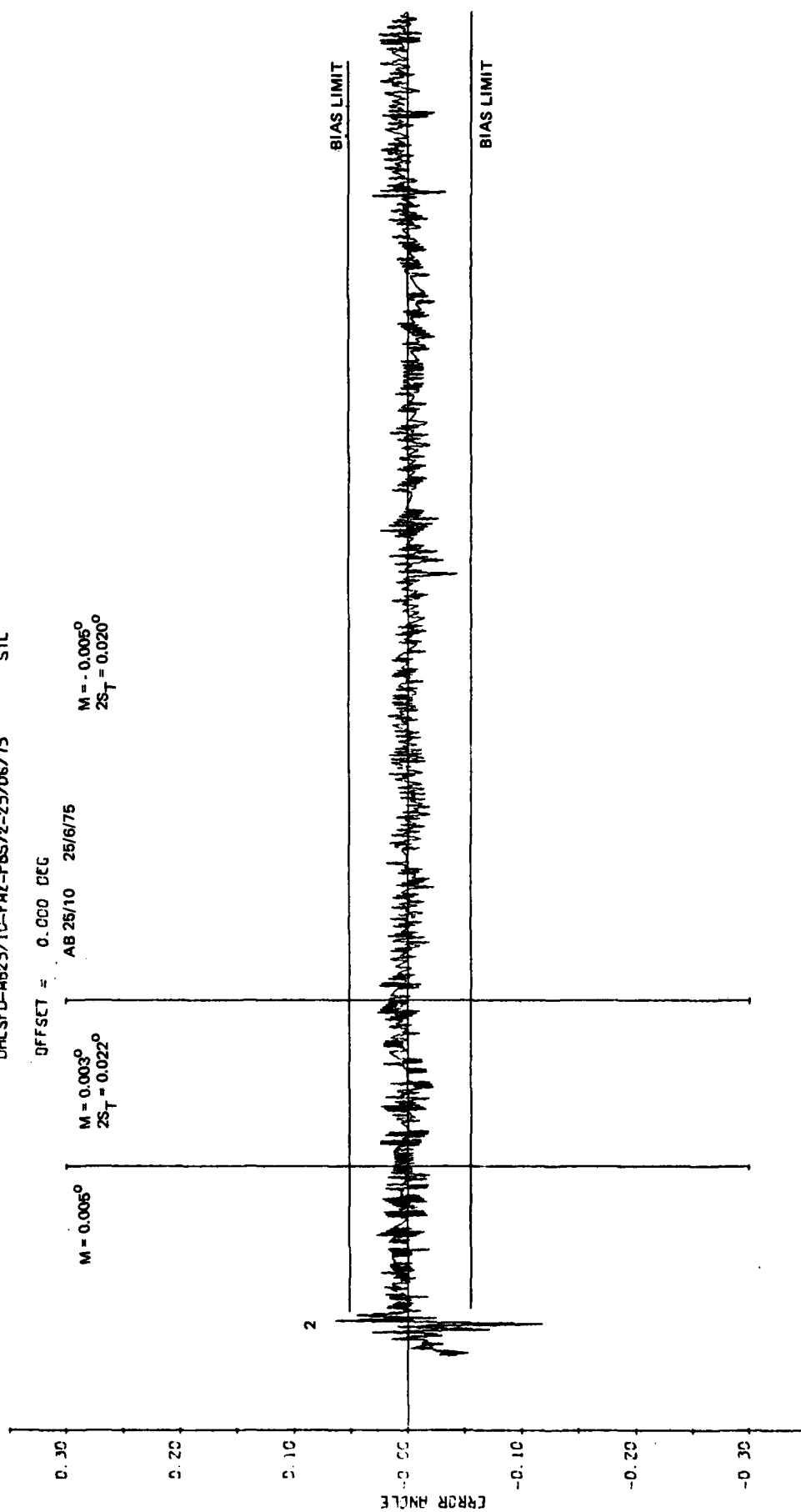


Fig 4.32c Approach azimuth accuracy. 3 degree approach to land and roll out

Fig 4.33a

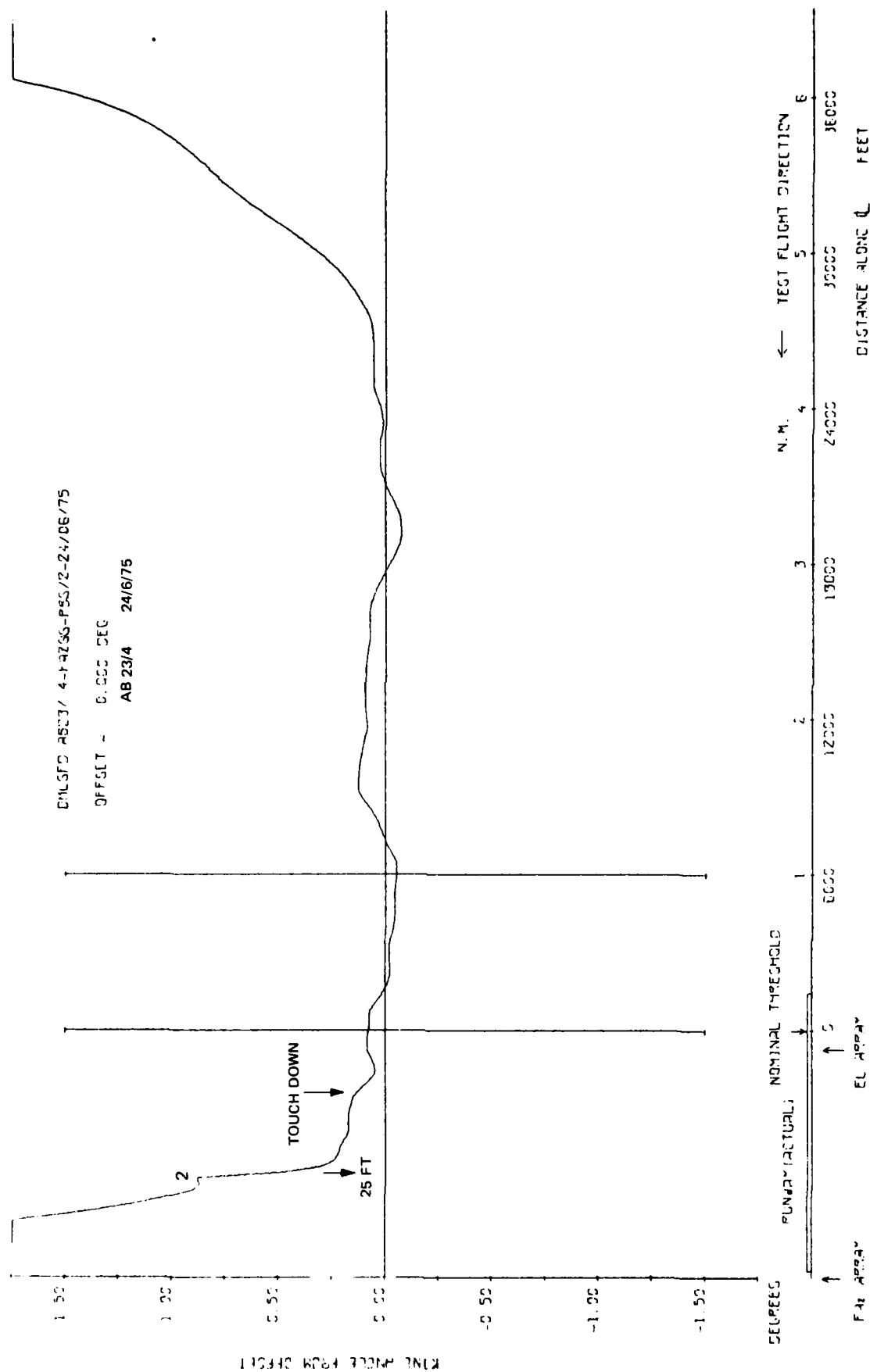
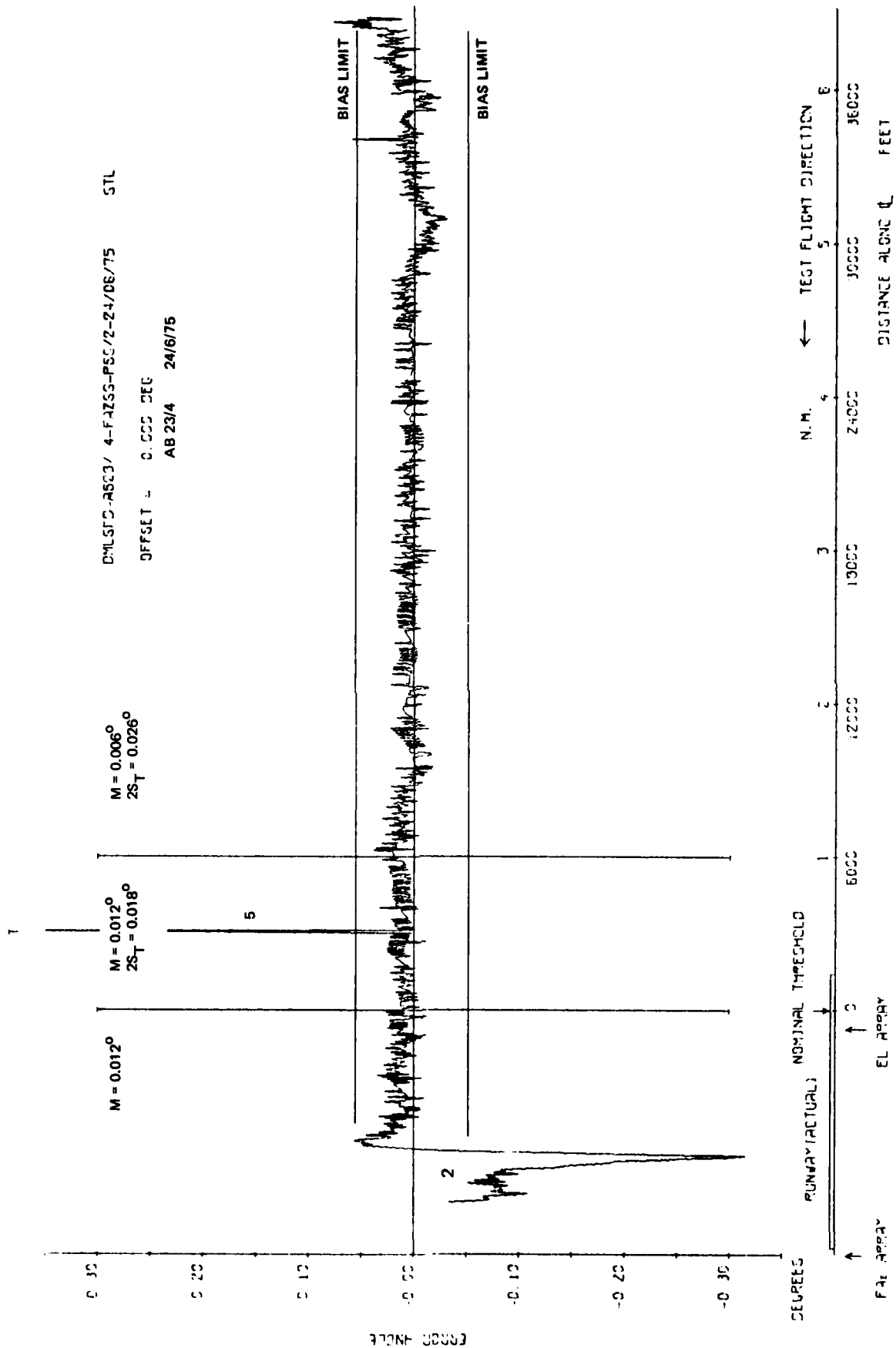


Fig 4.33a Approach azimuth accuracy. 3 degree approach to touch and go



DMLSLC-ABZ4/ E-F4Z-PBS/2-24/06/75
OFFSET = 0.000 DEG
AB 24/6 24/6/75

KIN ANGLE FROM OFFSET

DEGREES

1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50

170 FT
85 FT

RUNWAY (ACTUAL)
NOMINAL THRESHOLD

EL ARRAY

N.M.

← TEST FLIGHT DIRECTION

DISTANCE ALONG CL FEET

0 1 2 3 4 5 6
0000 10000 20000 30000 36000

Fig 4.34a Approach azimuth accuracy. 3 degree approach to low overfly

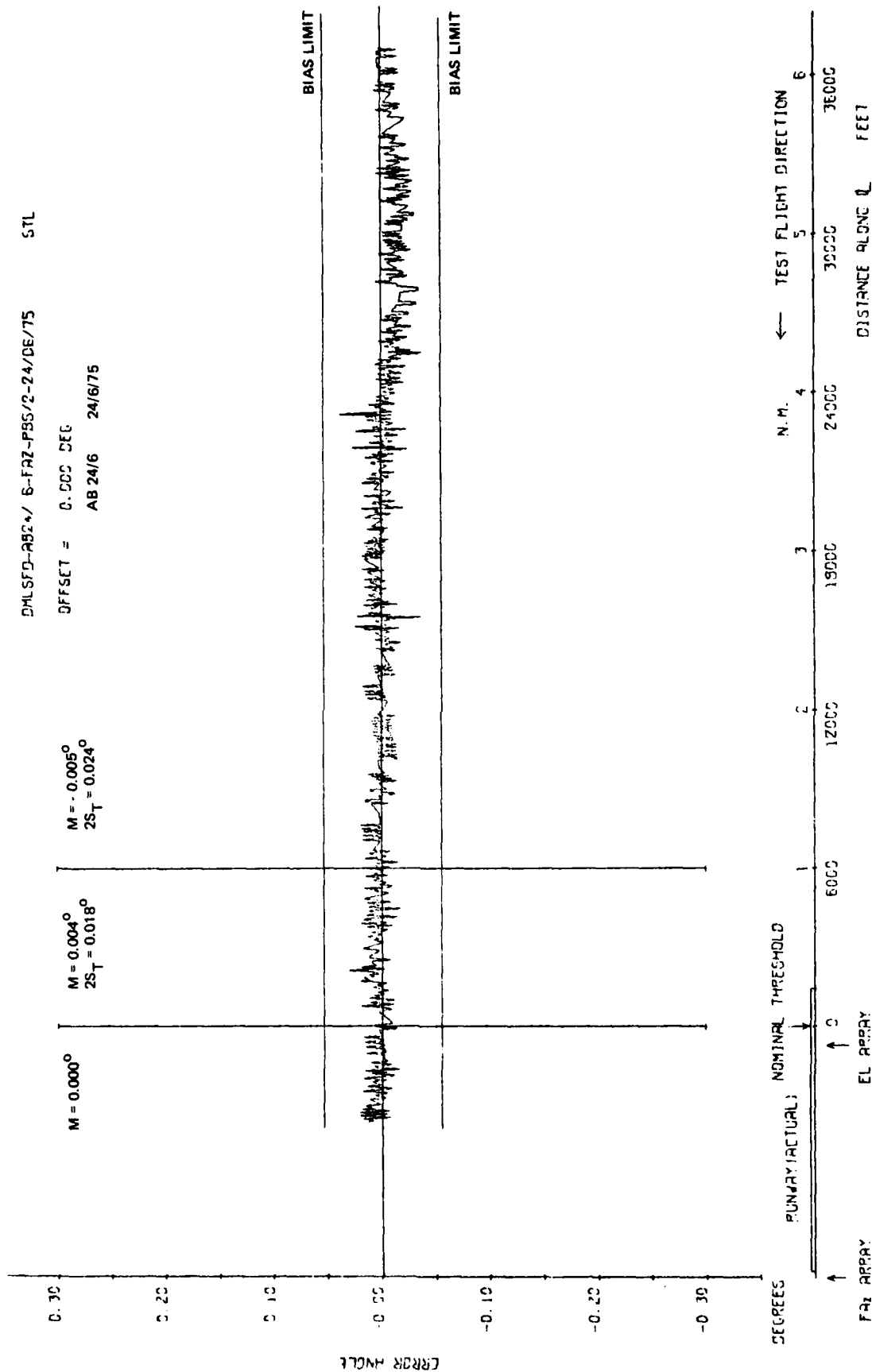
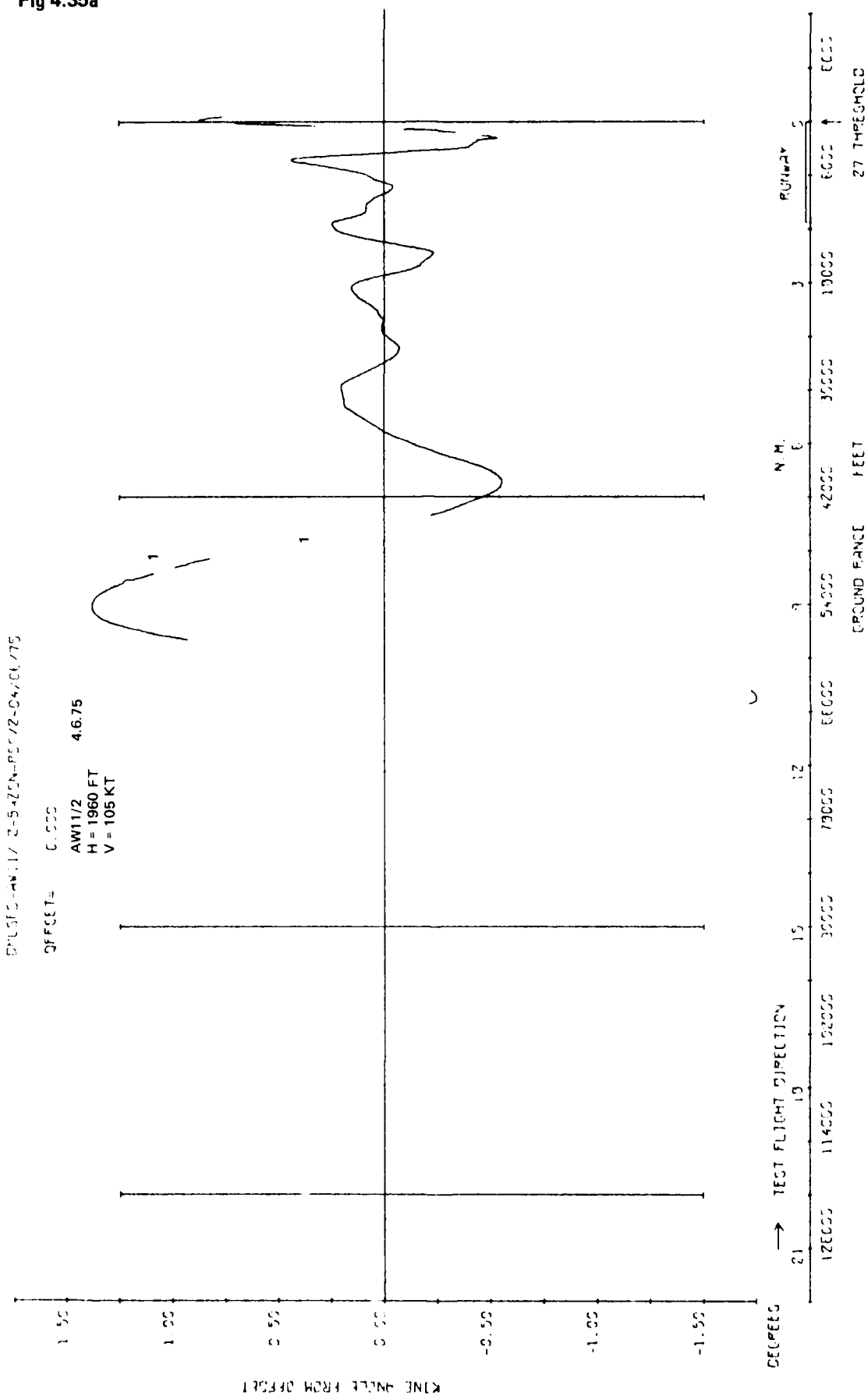


Fig 4.34c

Fig 4.34c Approach azimuth accuracy. 3 degree approach to low overfly

Fig 4.35a



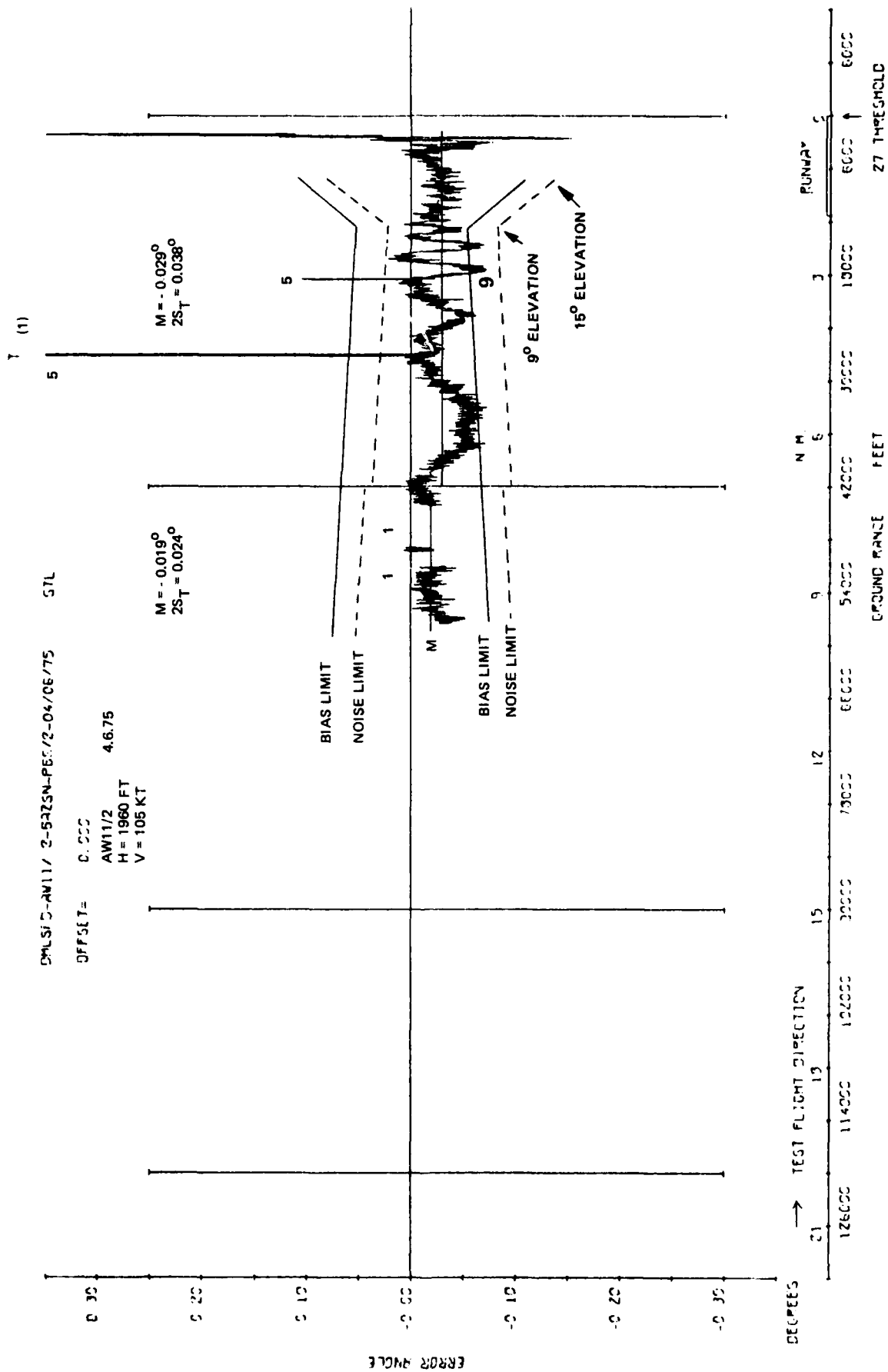


Fig 4.35c

Fig 4.35c Missed approach azimuth radial flight on centre line

AD-A085 479 ROYAL AIRCRAFT ESTABLISHMENT FARNBOROUGH (ENGLAND) F/6 17/7
CONTRIBUTIONS TO THE UK MICROWAVE LANDING SYSTEM RESEARCH AND D--ETC(U)
MAY 79 J M JONES
UNCLASSIFIED RAE-TR-79052-VOL-2 DRIC-BR-73762 NL

ROYAL AIRCRAFT ESTABLISHMENT FARNBOROUGH (ENGLAND) F/6 17/7
CONTRIBUTIONS TO THE UK MICROWAVE LANDING SYSTEM RESEARCH AND D--ETC(U)
MAY 79 J M JONES
RAE-TR-79052-VOL-2 DRIC-BR-73762 NL

F/6 17/7

DRIC-BR-73762

NL

2.2

AD
ACORN

END

DATE
FURNISHED

7.90

NTIC

Fig 4.36c

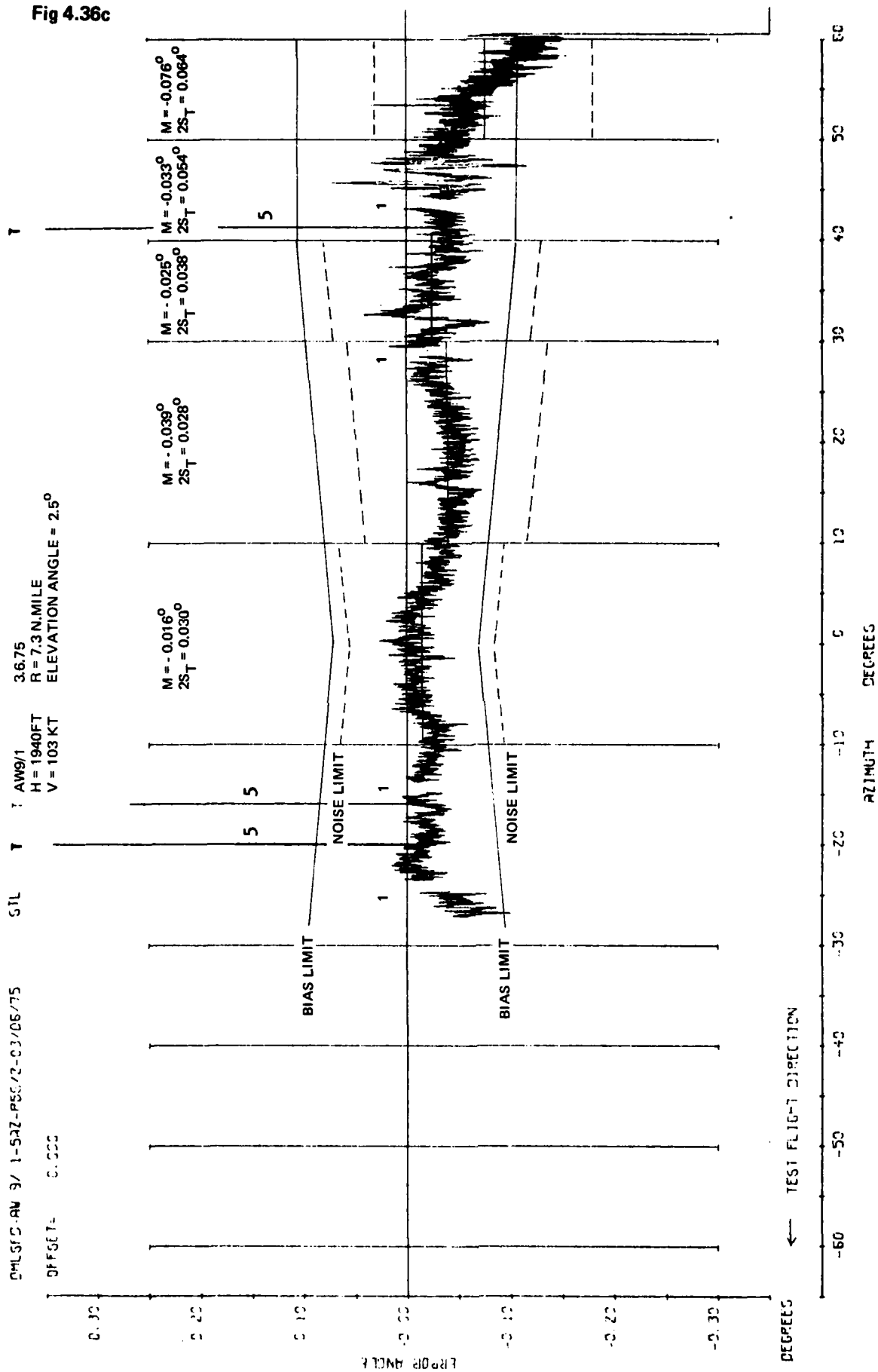


Fig 4.36c Missed approach azimuth orbital flight at 1940 ft and 7.3 n mile radius

DHLSD-AW 9/ 3-54Z-PDC/2-03/06/75 STL

OFFSET = 0.000

AW9/3 36.75
H = 1940 FT R = 7.3 N.MILE
V = 130 KT ELEVATION ANGLE = 2.6°

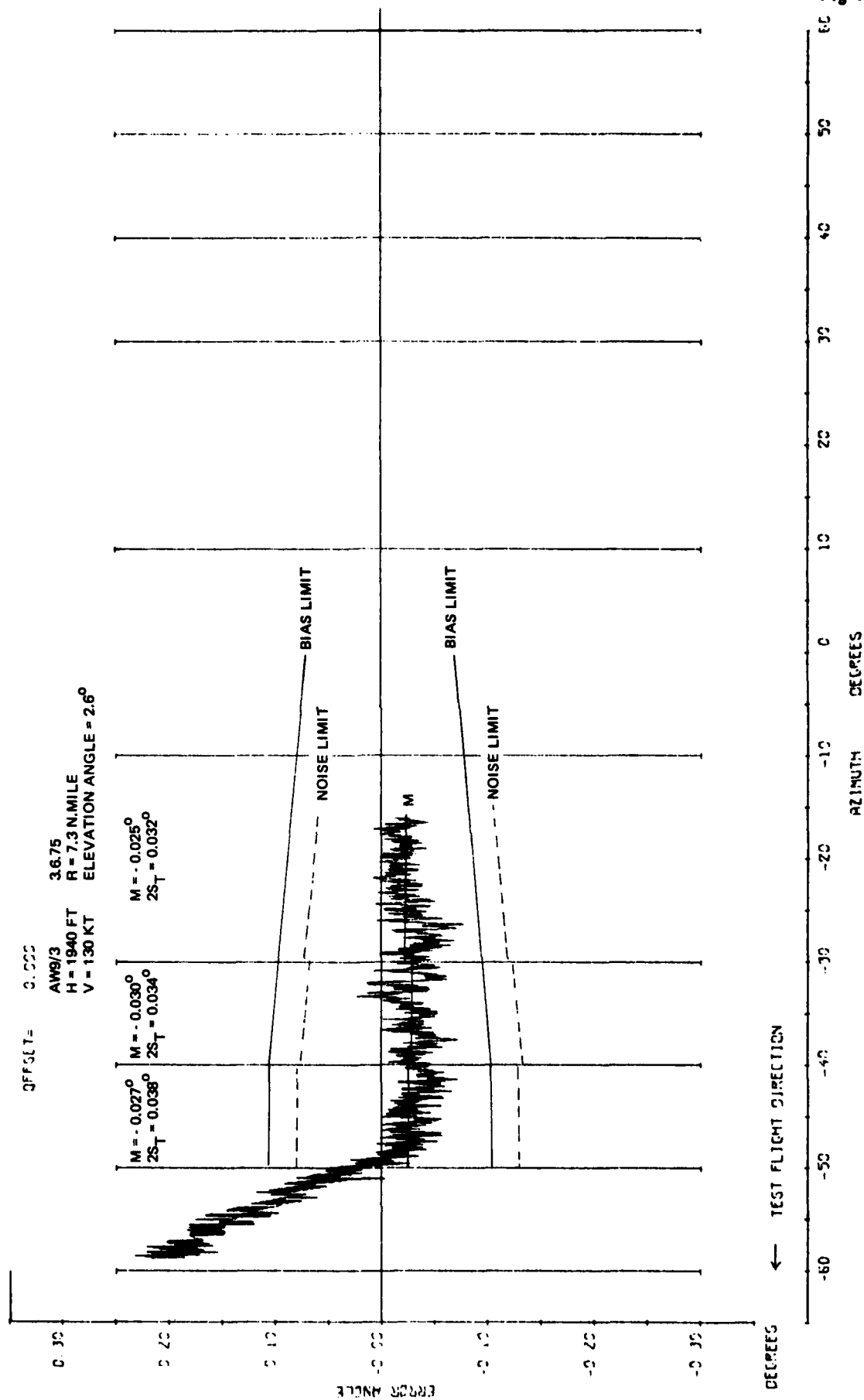


Fig 4.37c Missed approach orbital flight at 1940 ft and 7.3 n mile radius

OMLSFD-AW16/ 1-5RZSN-PSS/2-13/05/75 STC

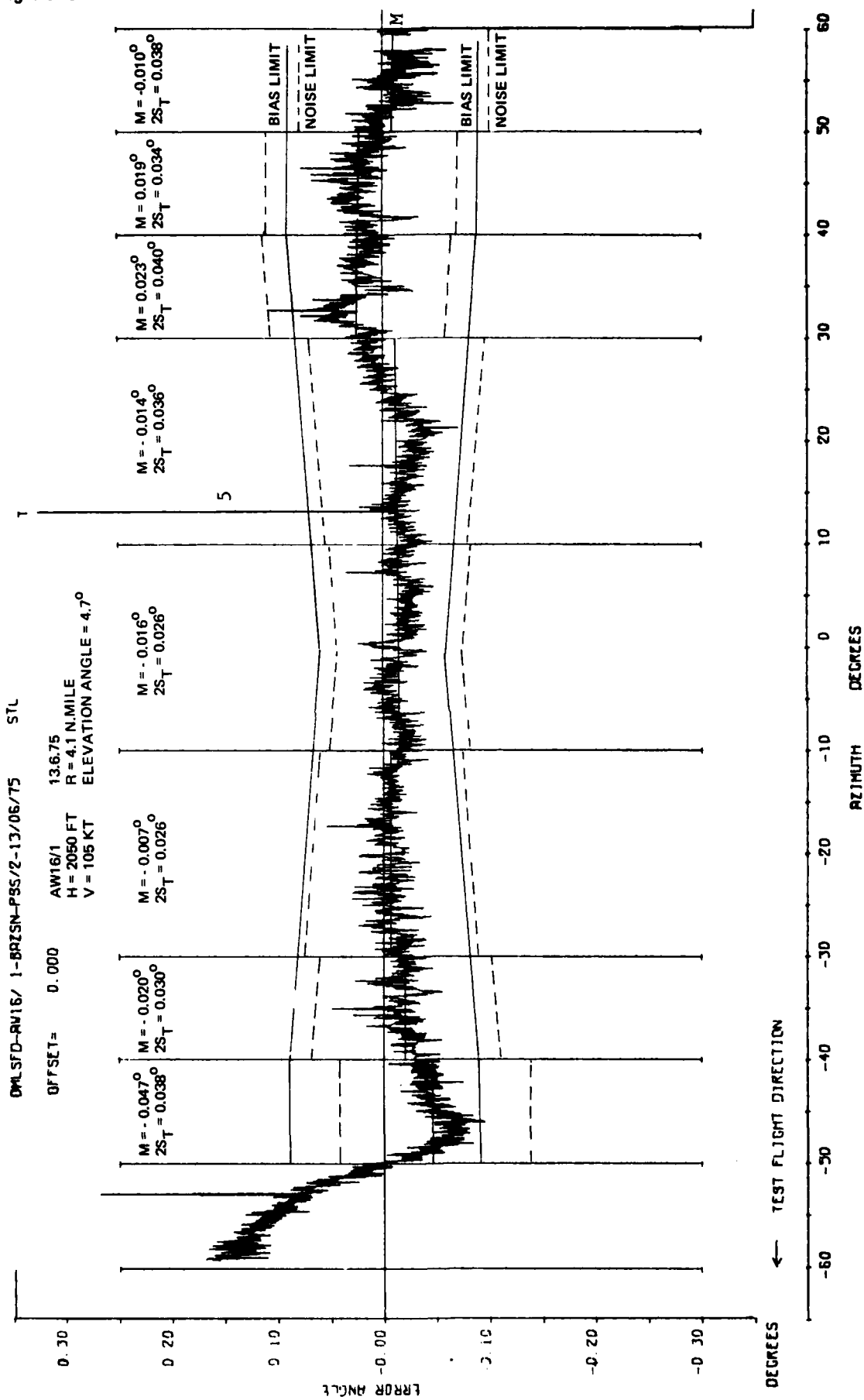


Fig 4.38c Missed approach orbital flight at 2050 ft and 4.1 n mile radius

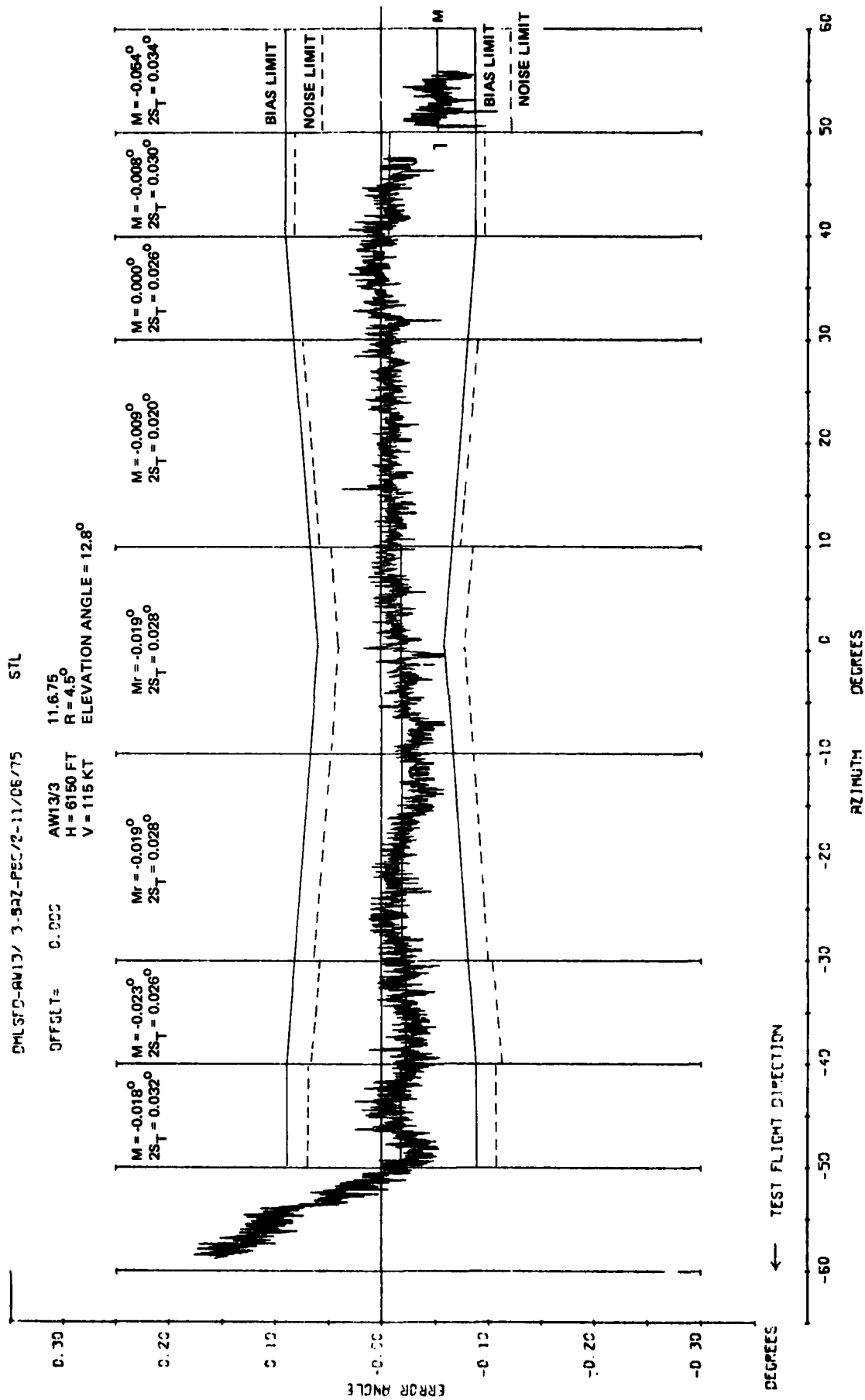


Fig 4.39c Missed approach azimuth orbital flight at 6150 ft and 4.5 n mile radius

Fig 4.40a

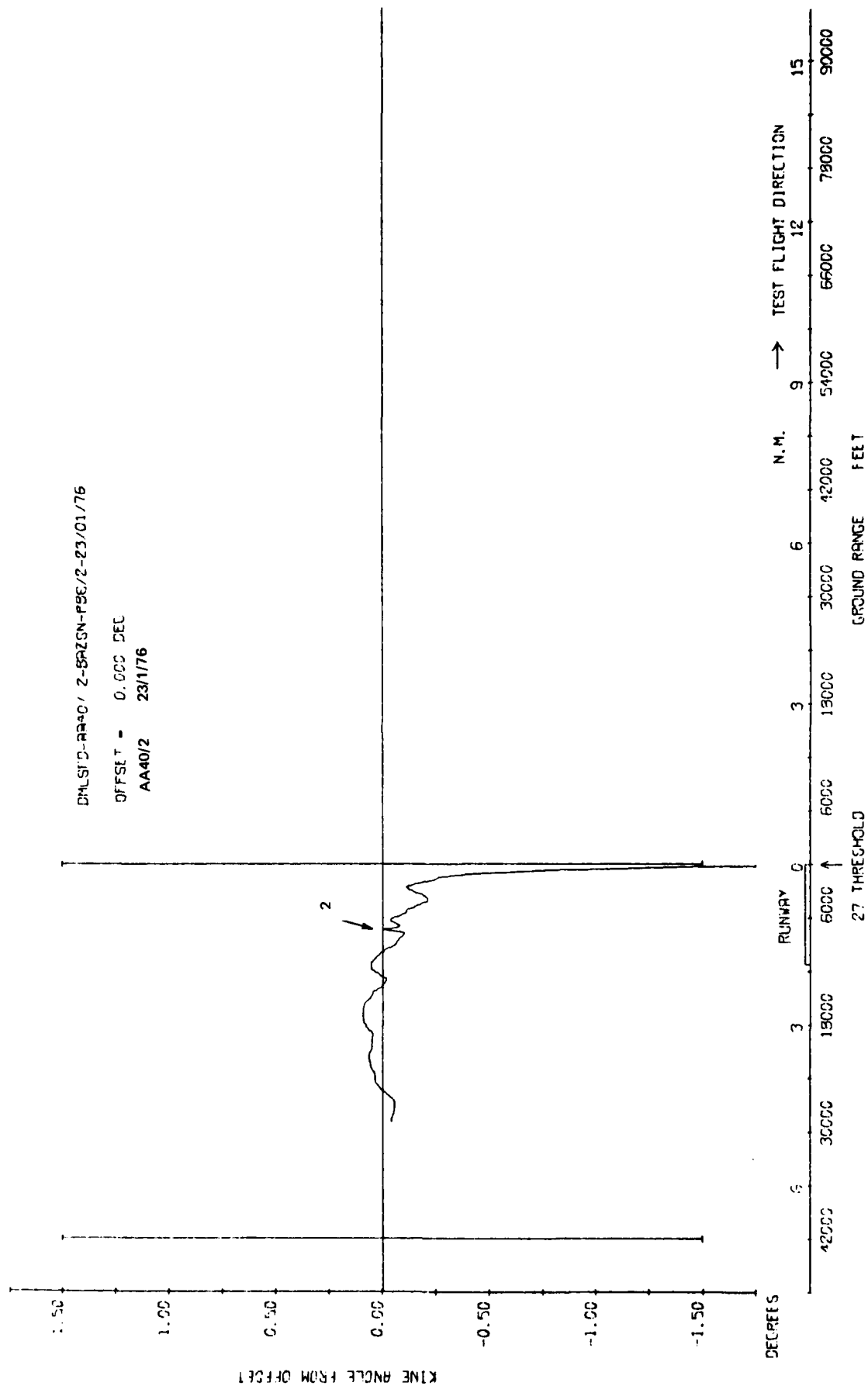


Fig 4.40a 3 degree approach using 60λ array missed approach guidance to low overshoot

TR 79052

DMLS/D-AA40/ 2-BRZEN-P86/2-23/01/76 STL

OFFSET = 0.000 DEG

AA40/2 23/1/75

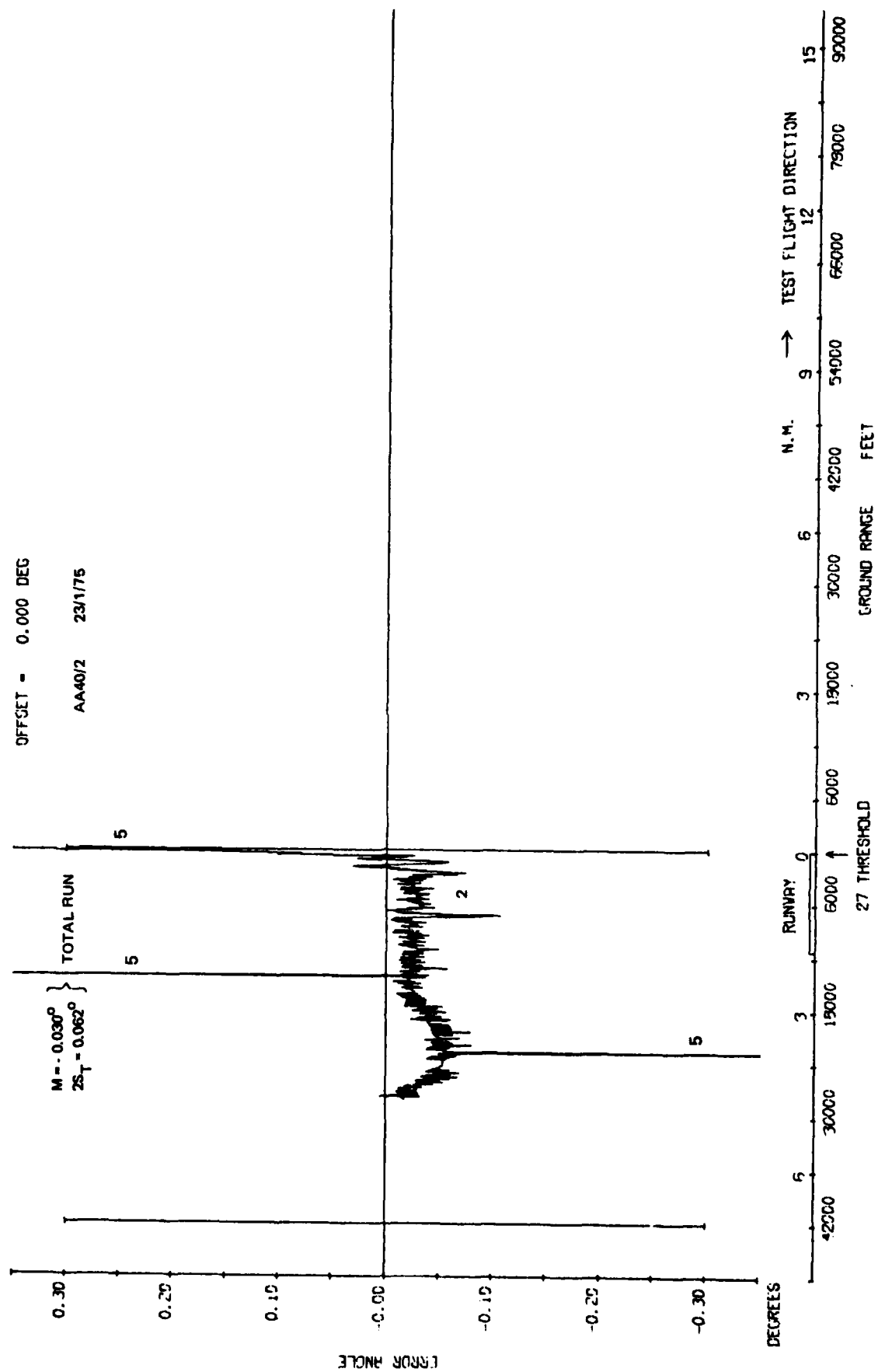


Fig 4.40c 3 degree approach using 60λ array missed approach guidance to low overshoot

Fig 4.41a

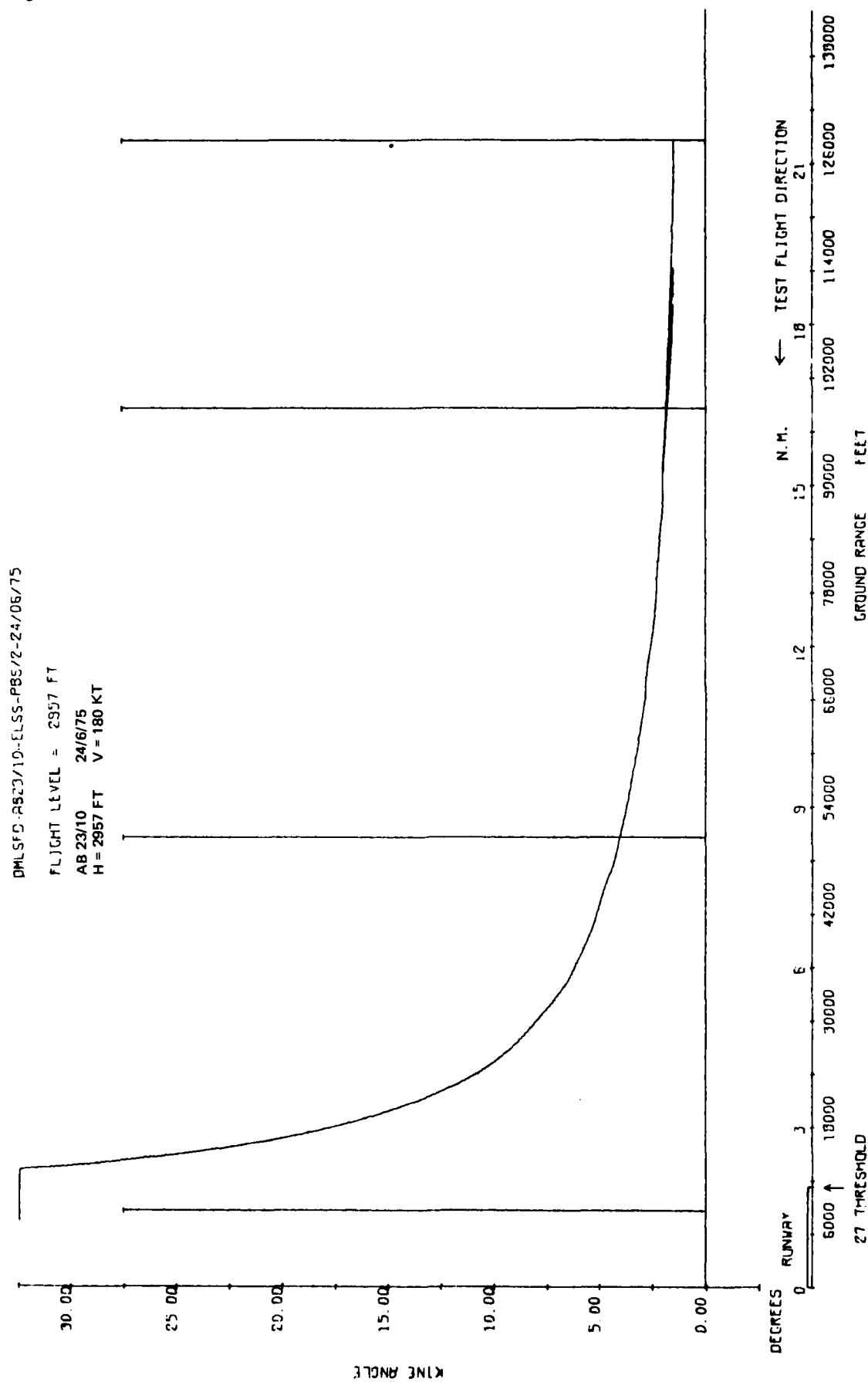


Fig 4.41a Elevation accuracy. Radial flight at 2957 ft and 0 degree

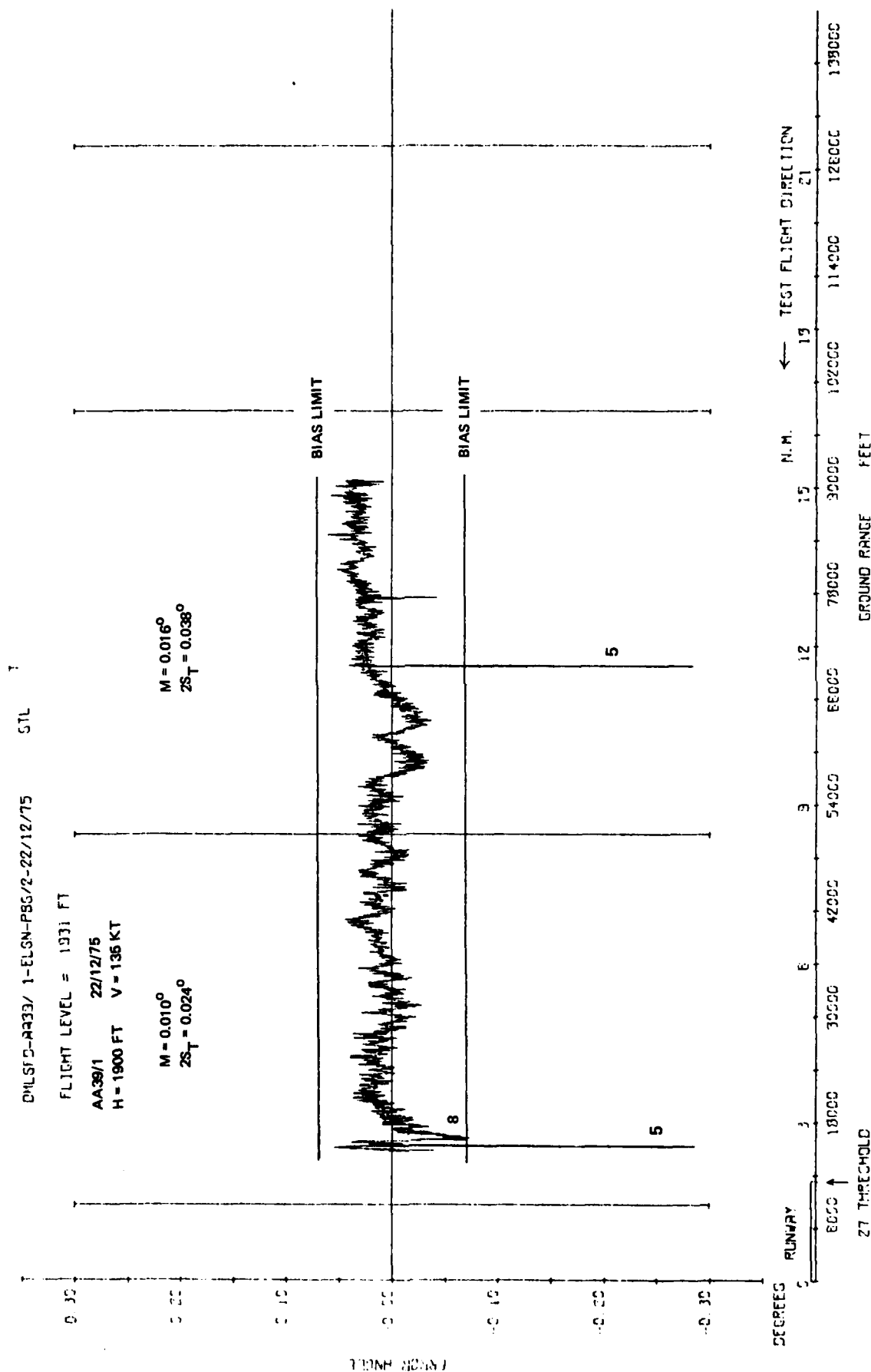


Fig 4.42c

Fig 4.42c Elevation accuracy radial flight at 1900 ft and on -44 degrees radial

Fig 4.43a

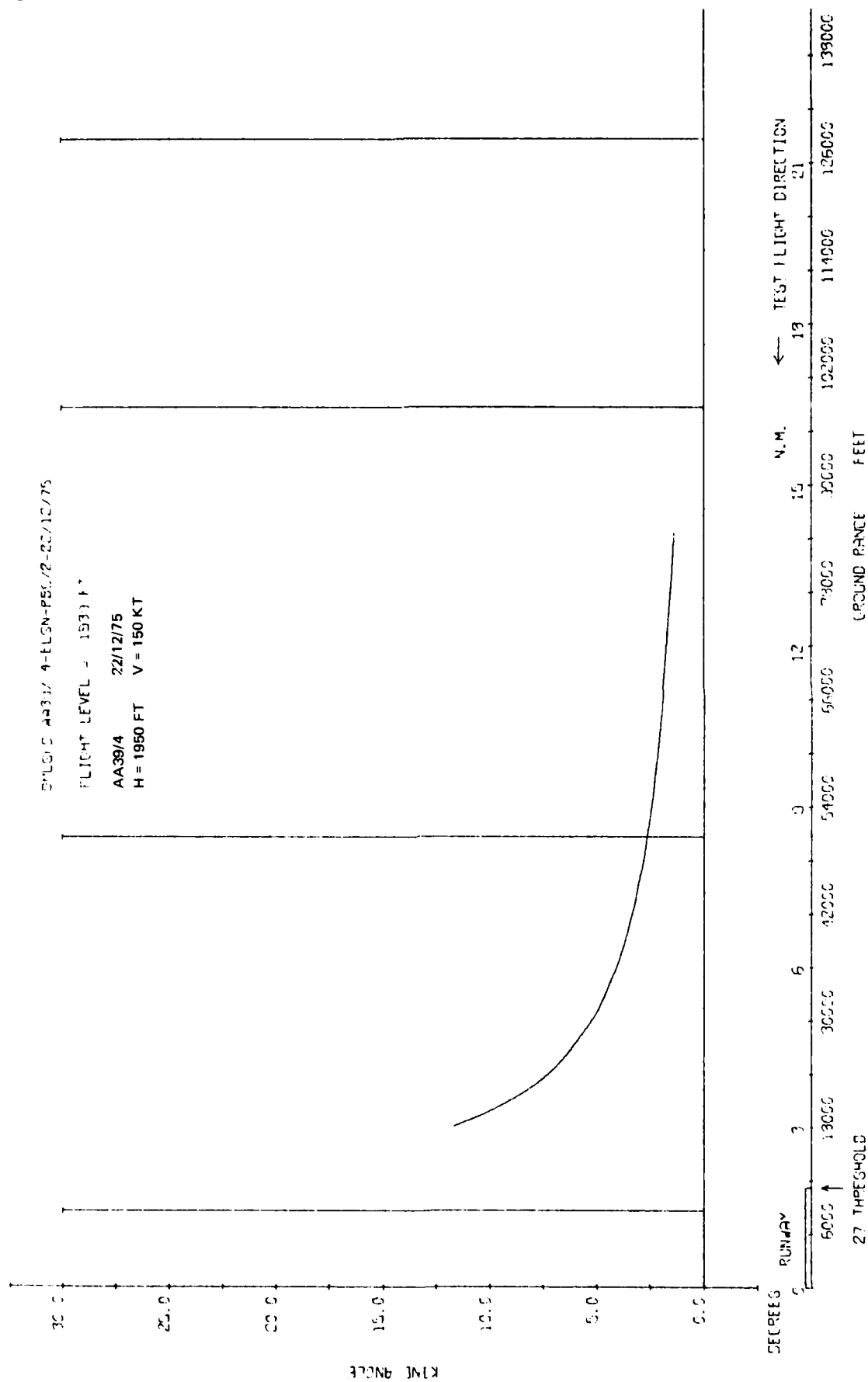


Fig 4.43a Elevation accuracy radial flight at 1950 ft and on +51 degrees radial

Fig 4.44a

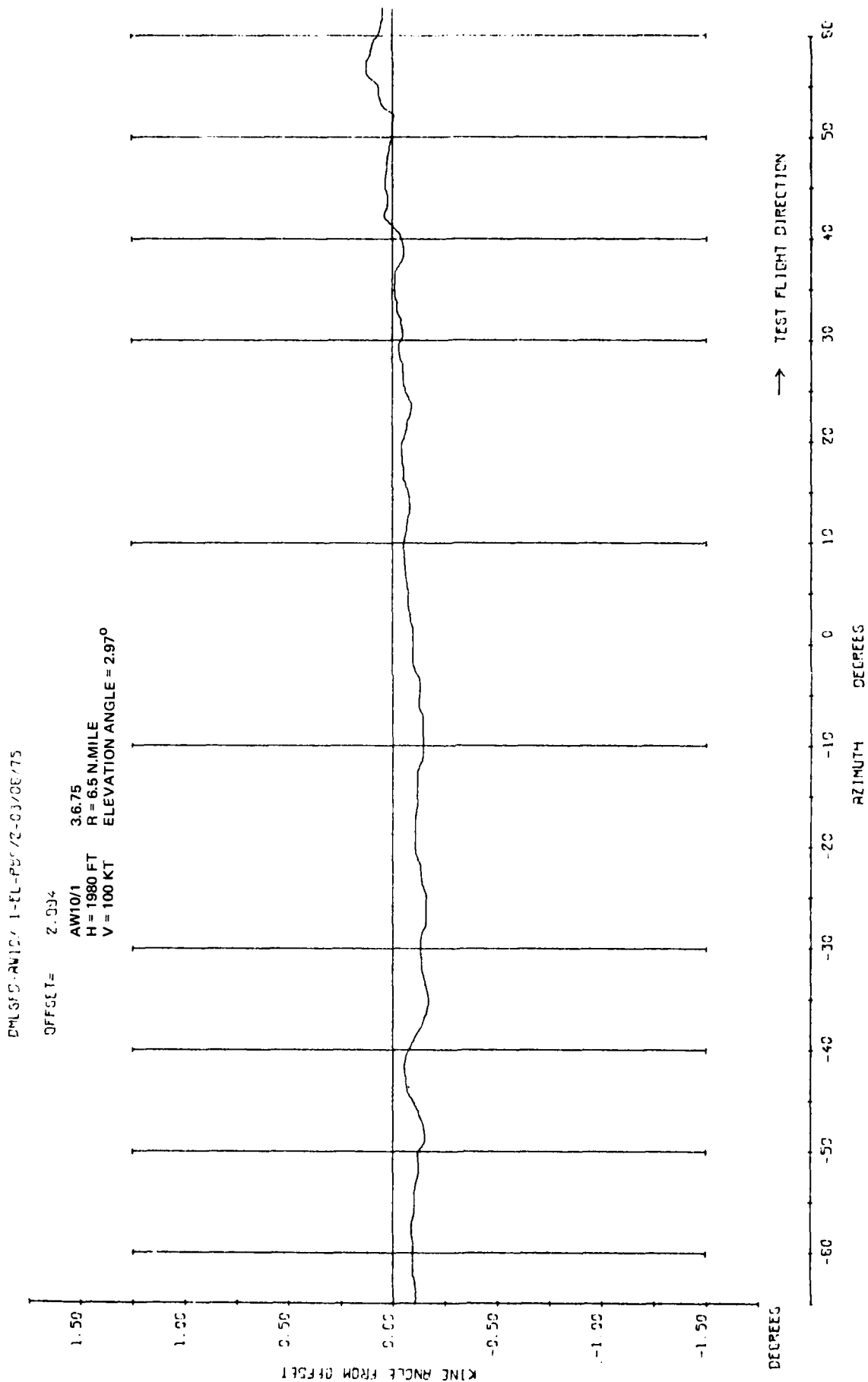


Fig 4.44a Elevation orbital flight at 1980 ft and 6.5 n mile radius

DNLSFD-AW12/ 1-EL-PDS/2-03/CE/75 STL

OFFSET= 2.334

AW10/1 3.675

H=1980 FT R=6.5 N.MILE
V=100 K.T ELEVATION ANGLE = 2.97°

T (1)

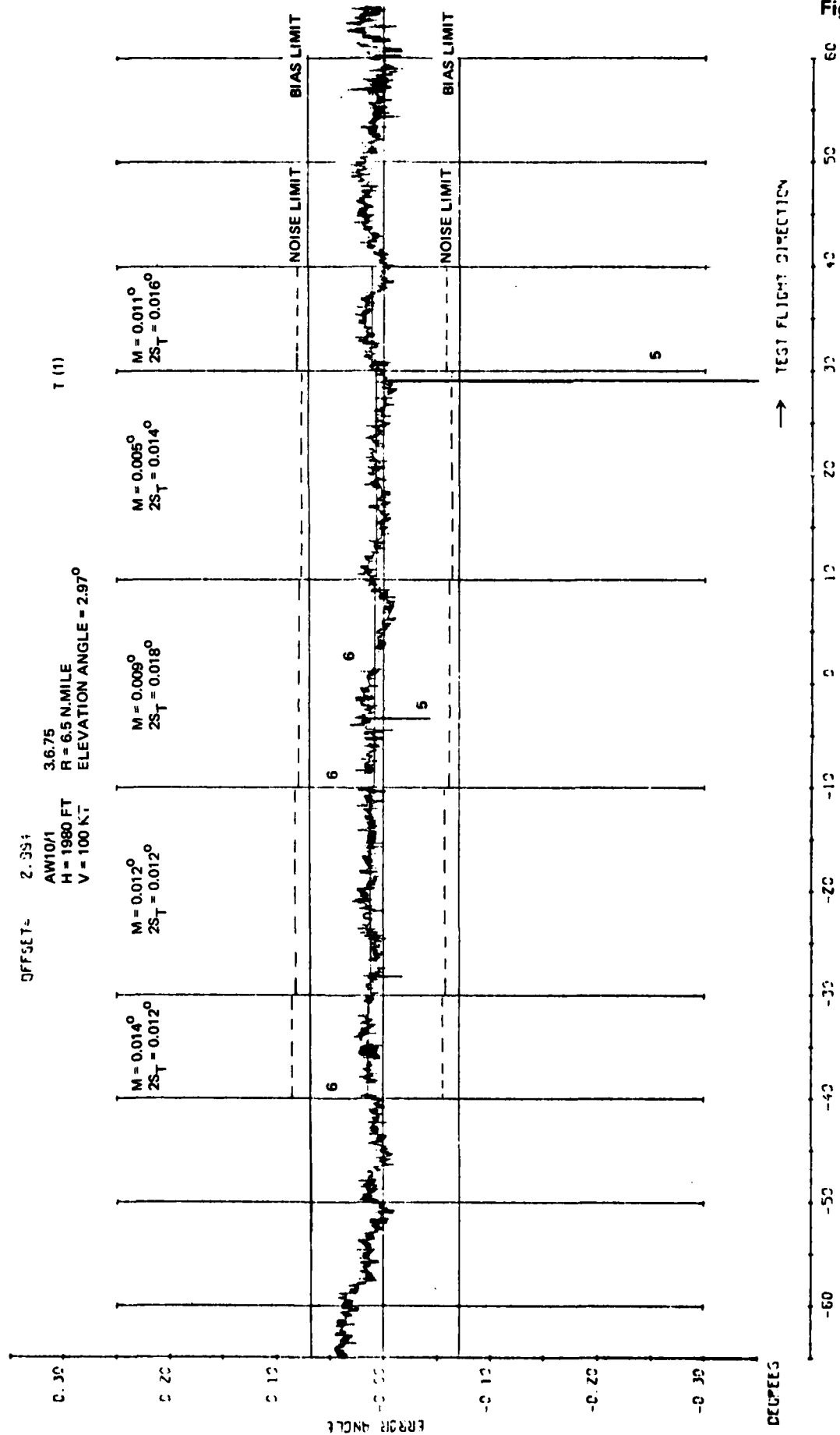


Fig 4.44c Elevation orbital flight at 1980 ft and 6.5 n mile radius

Fig 4.45a

ORBITAL DATA 1-EL-PG/2-11/06/75

OFFSET - 0.002

AW 13/1 11.675

H = 4100 FT R = 4.1 N. MILE

V = 60 KT ELEVATION ANGLE = 9.5°

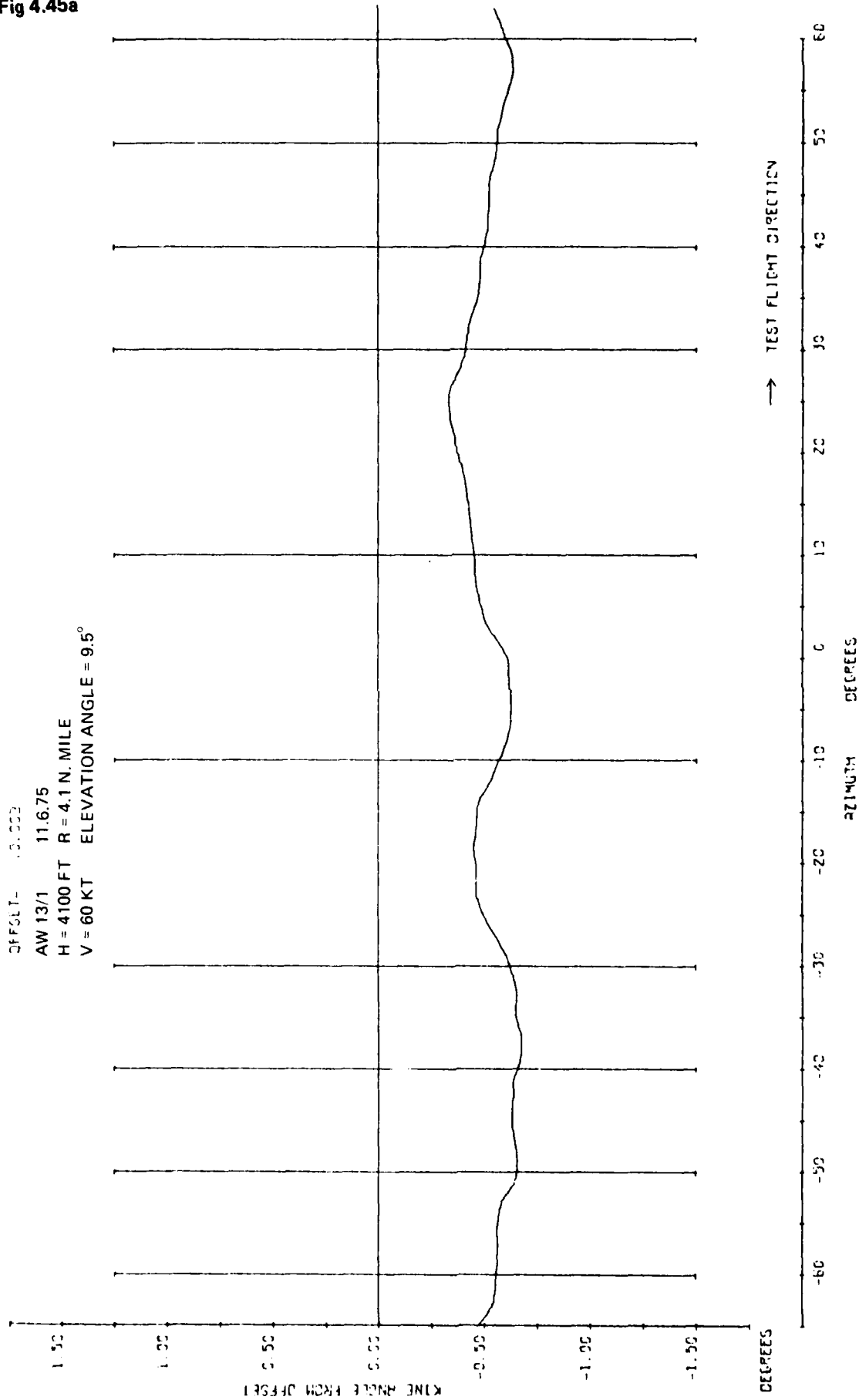


Fig 4.45a Elevation orbital flight at 4100 ft and 4.1 n mile radius



Fig 4.45c Elevation orbital flight at 4100 ft and 4.1 mile radius

Fig 4.46a/b

QMLSTO-8W14/ 4-ELSN-PBS/2-12/06/75 STL

RANGE = 14524 FT

AW14/4

12.675

AZIMUTH ANGLE = -32°

RATE OF ASCENT = 11 FT/SEC.

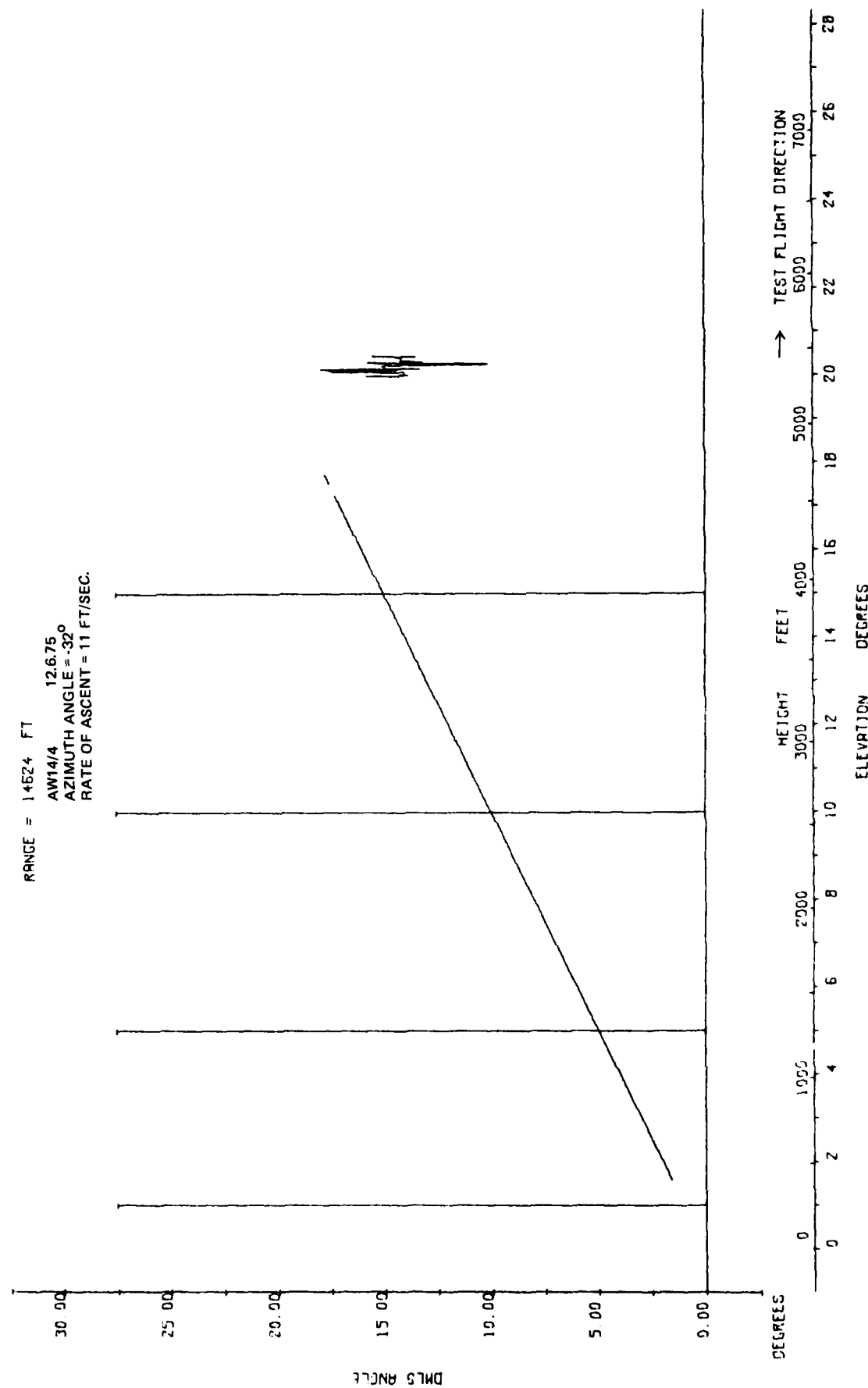


Fig 4.46a/b Elevation vertical ascent

DMLSFO-BV14/ 4-ELSN-P86/Z-12/06/75 STL

RANGE = 14624 FT

AW14/4 12.675

AZIMUTH ANGLE = -32°

RATE OF ASCENT = 11 FT/SEC.

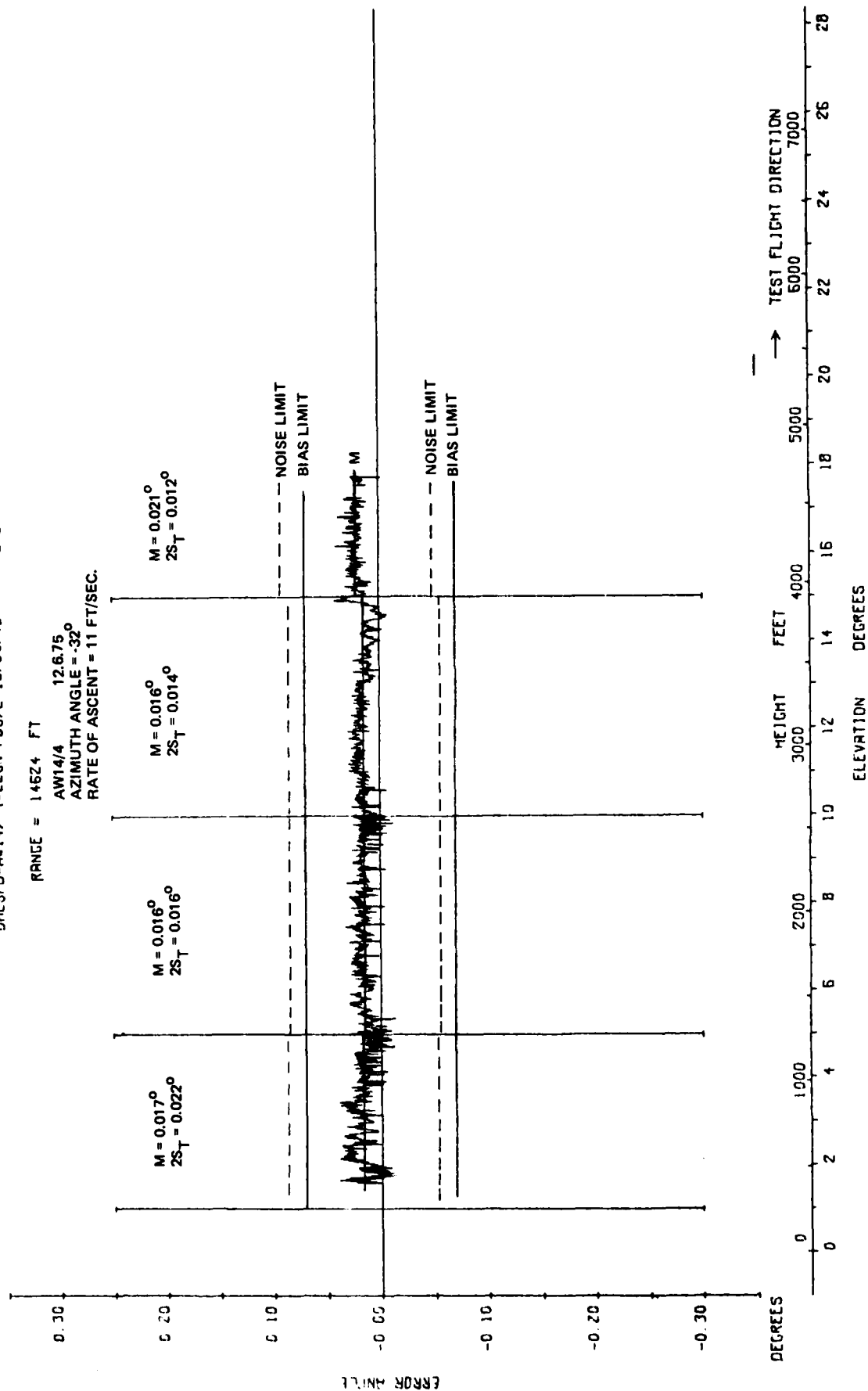


Fig 4.46c

Fig 4.46c Elevation vertical ascent

Fig 4.47a

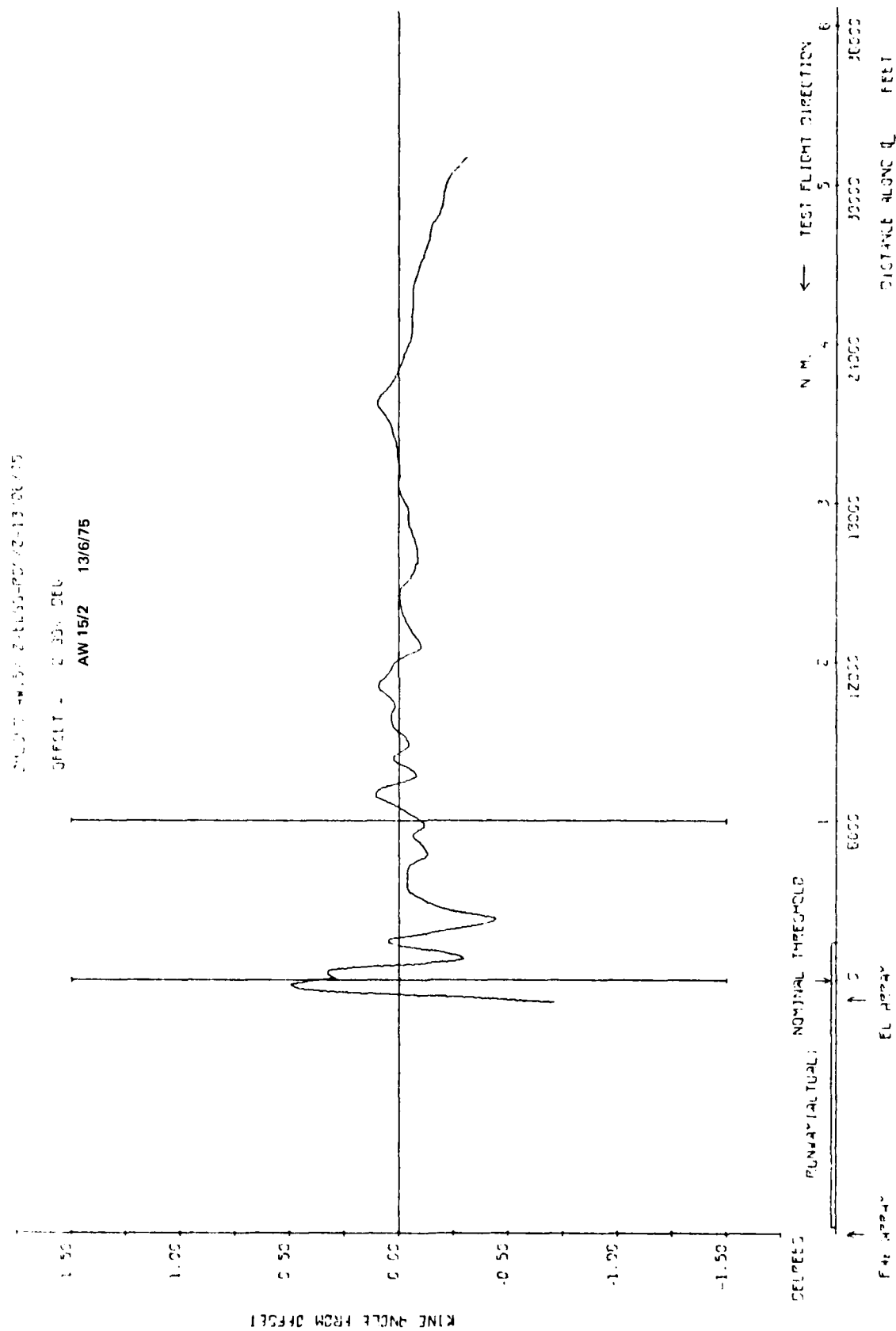


Fig 4.47a Elevation accuracy. 3 degree approach to touchdown

DHLSPD-AW15/ 2-ELSS-PBS/2-13/06/75 STL

OFFSET = 2.00 DEG

AW 15/2 13/6/75

$M = 0.006^\circ$
 $2S_T = 0.016^\circ$

$M = 0.007^\circ$
 $2S_T = 0.026^\circ$

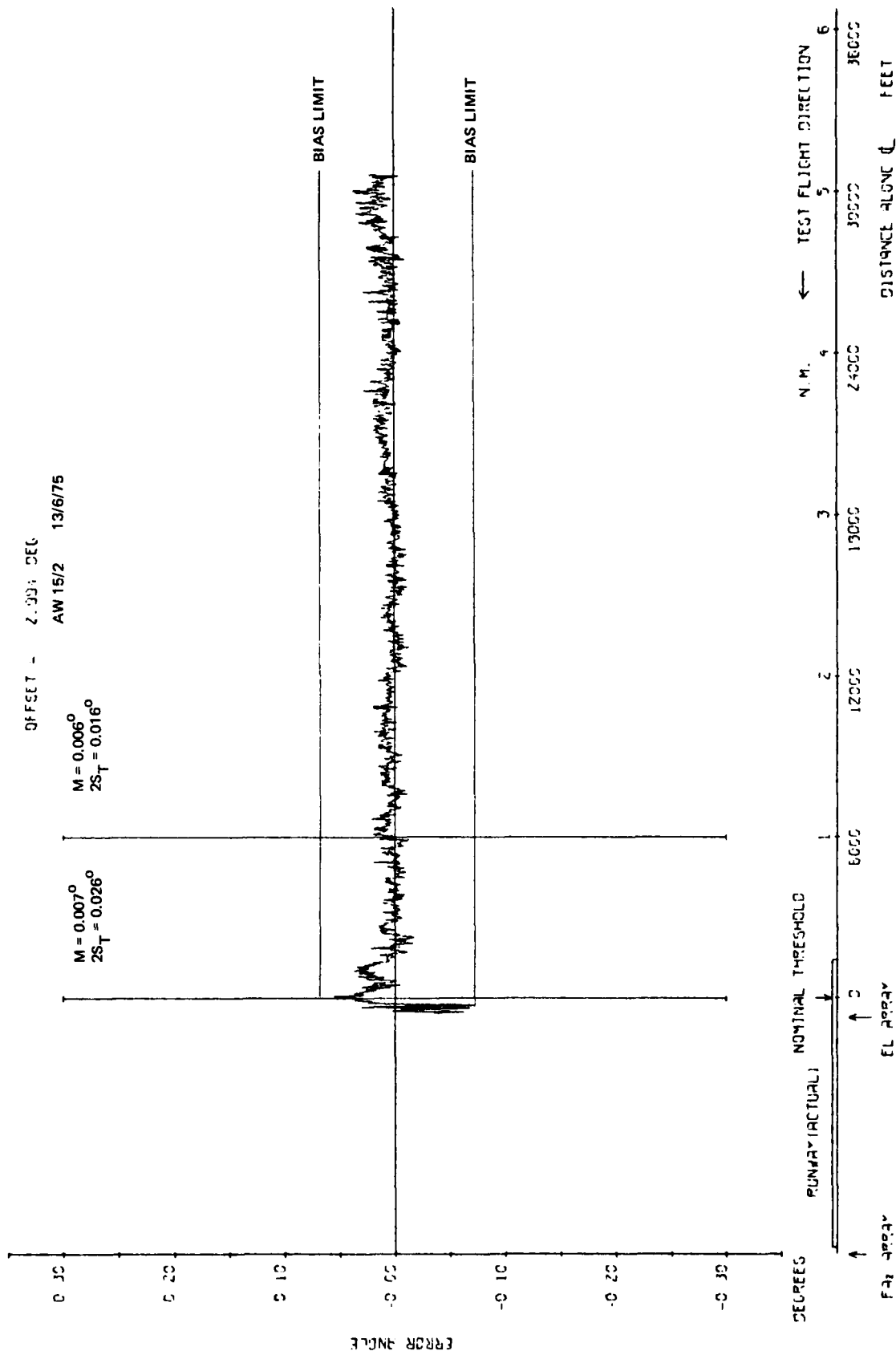


Fig 4.47c Elevation accuracy. 3 degree approach to touchdown

Fig 4.48a

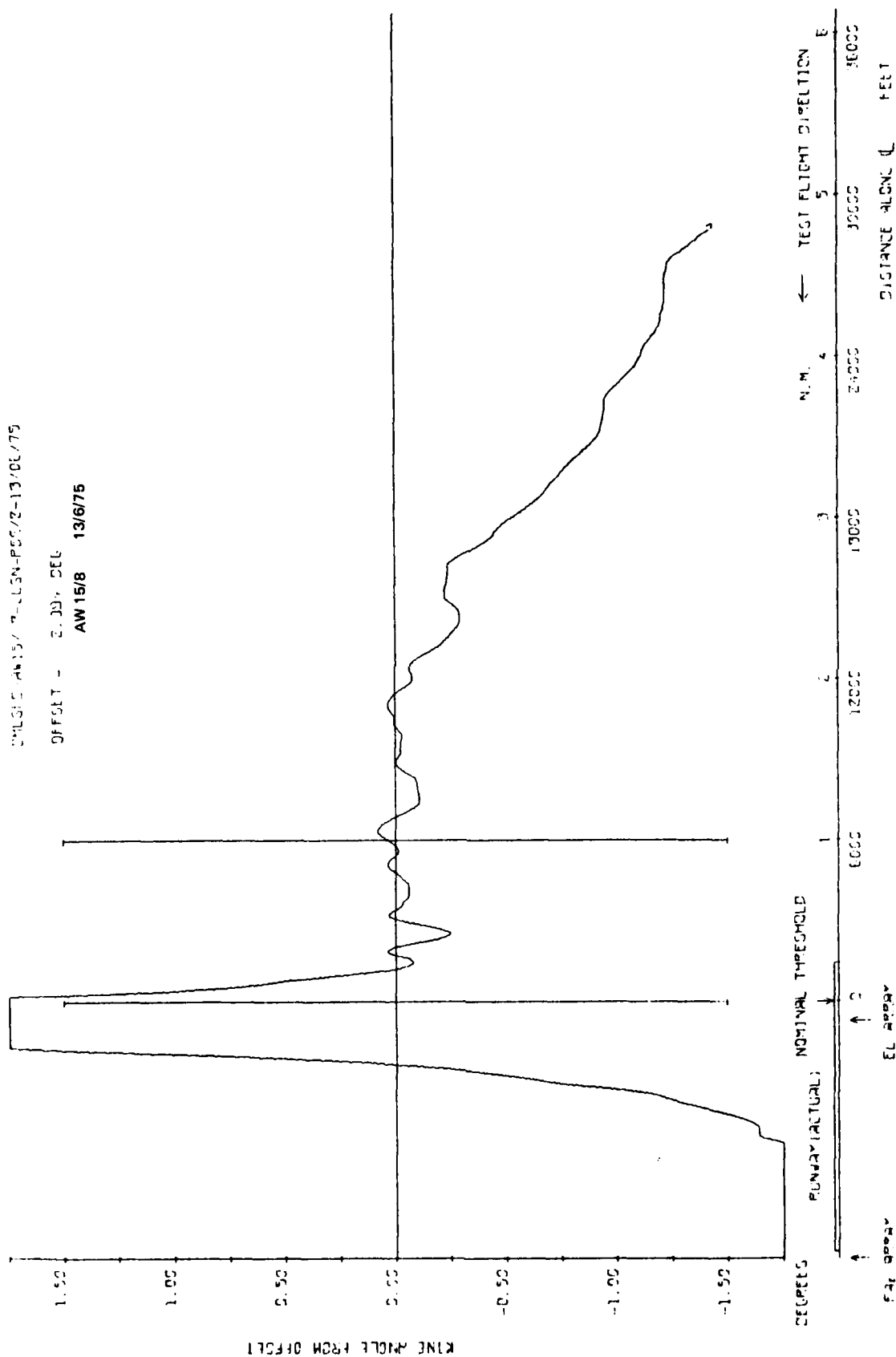


Fig.4.48a Elevation accuracy. 3 degree approach to 100 ft level overfly



Fig 4.49a

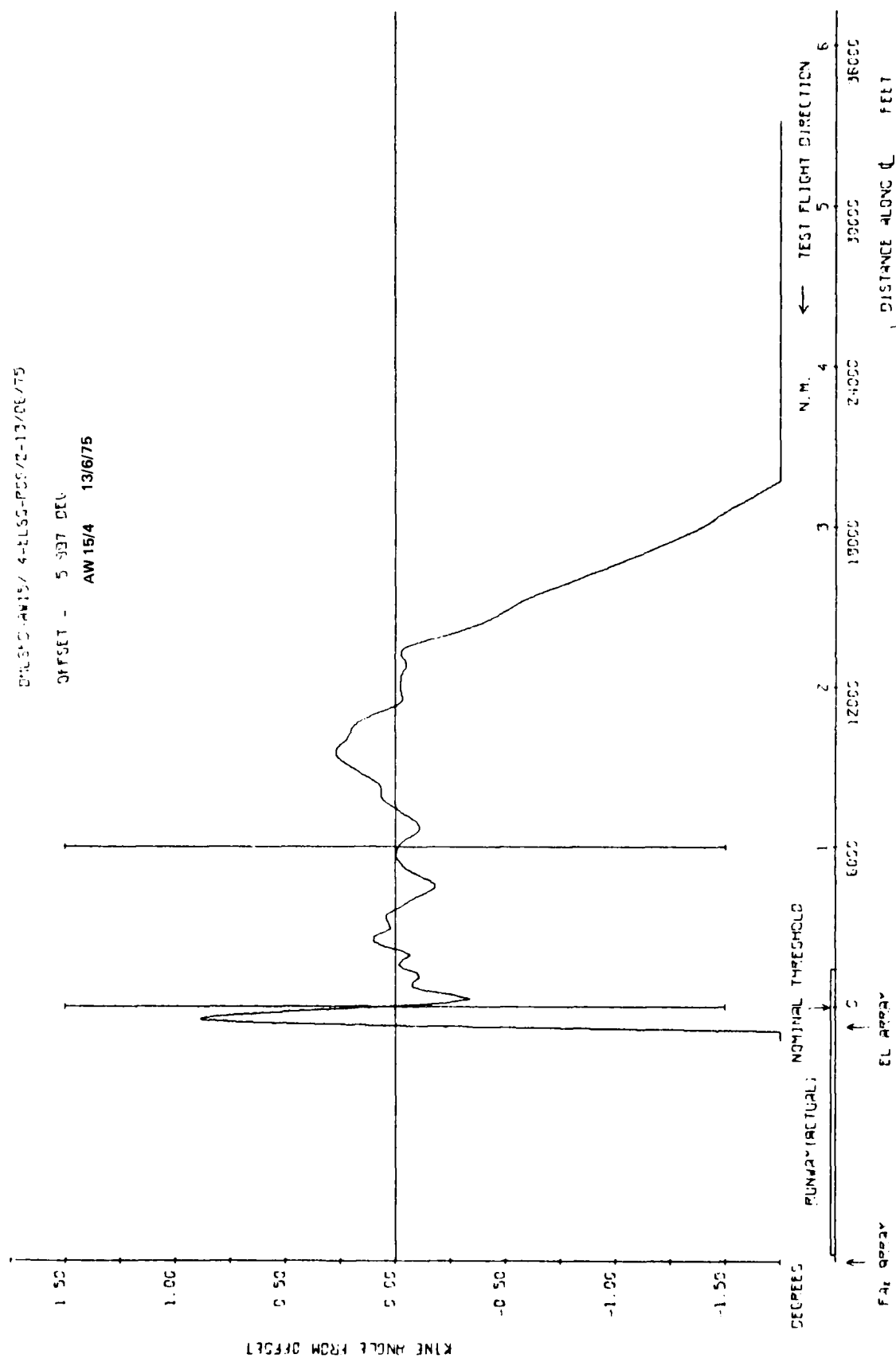


Fig 4.49a Elevation accuracy. 6 degree approach to 50 ft

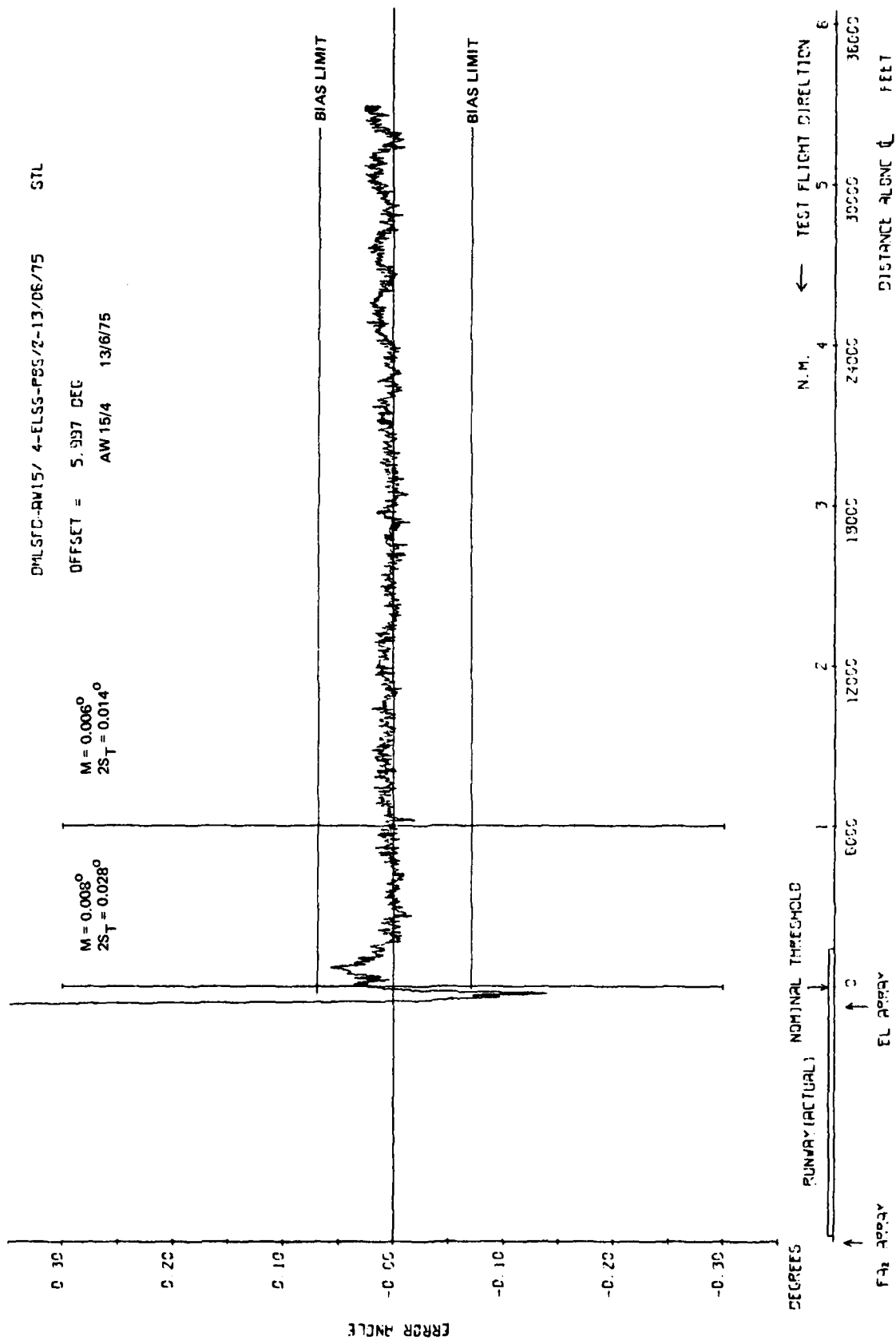


Fig 4.49c Elevation accuracy. 6 degree approach to 50 ft

Fig 4.50

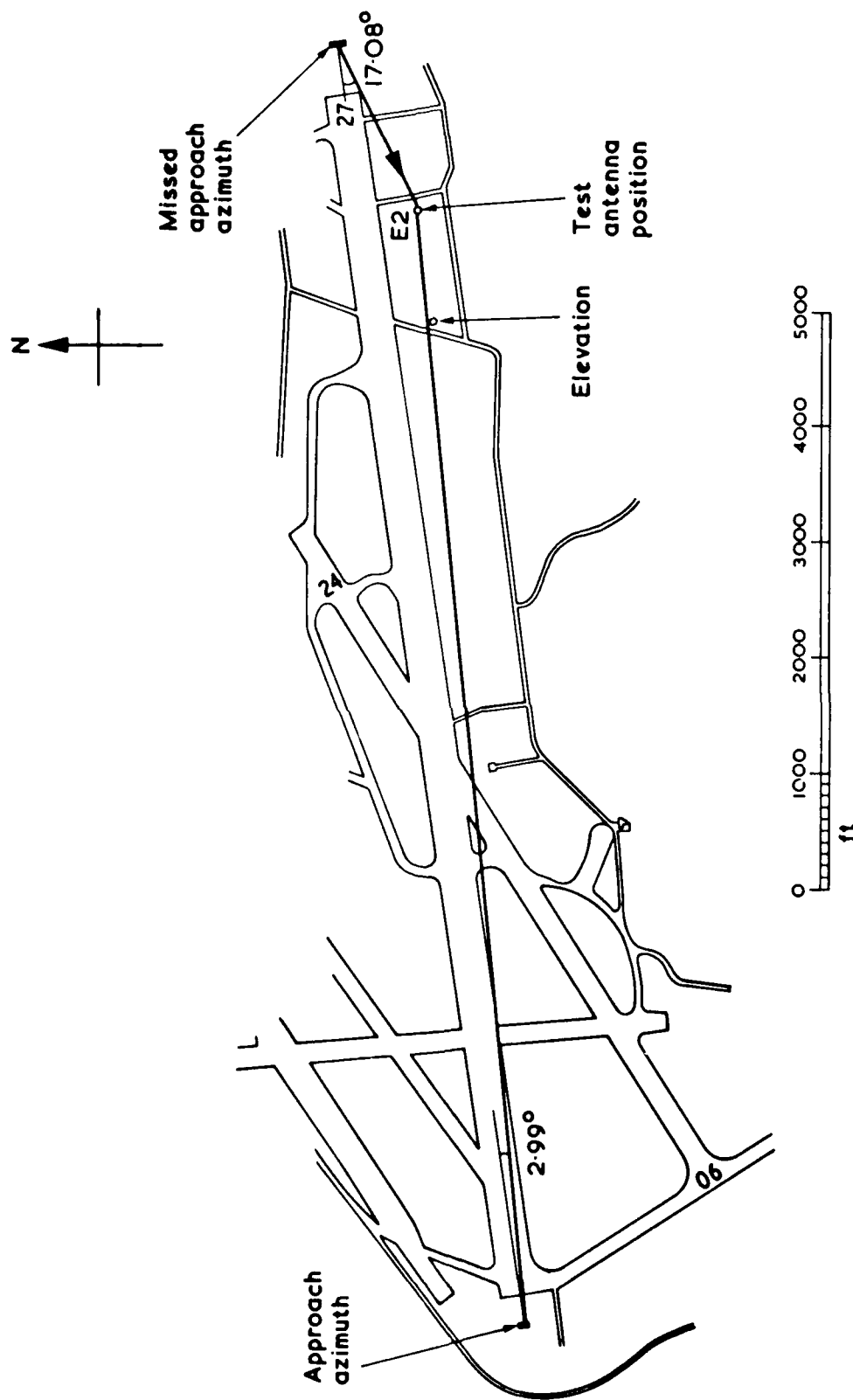


Fig 4.50 Stability test – general site plan Bedford

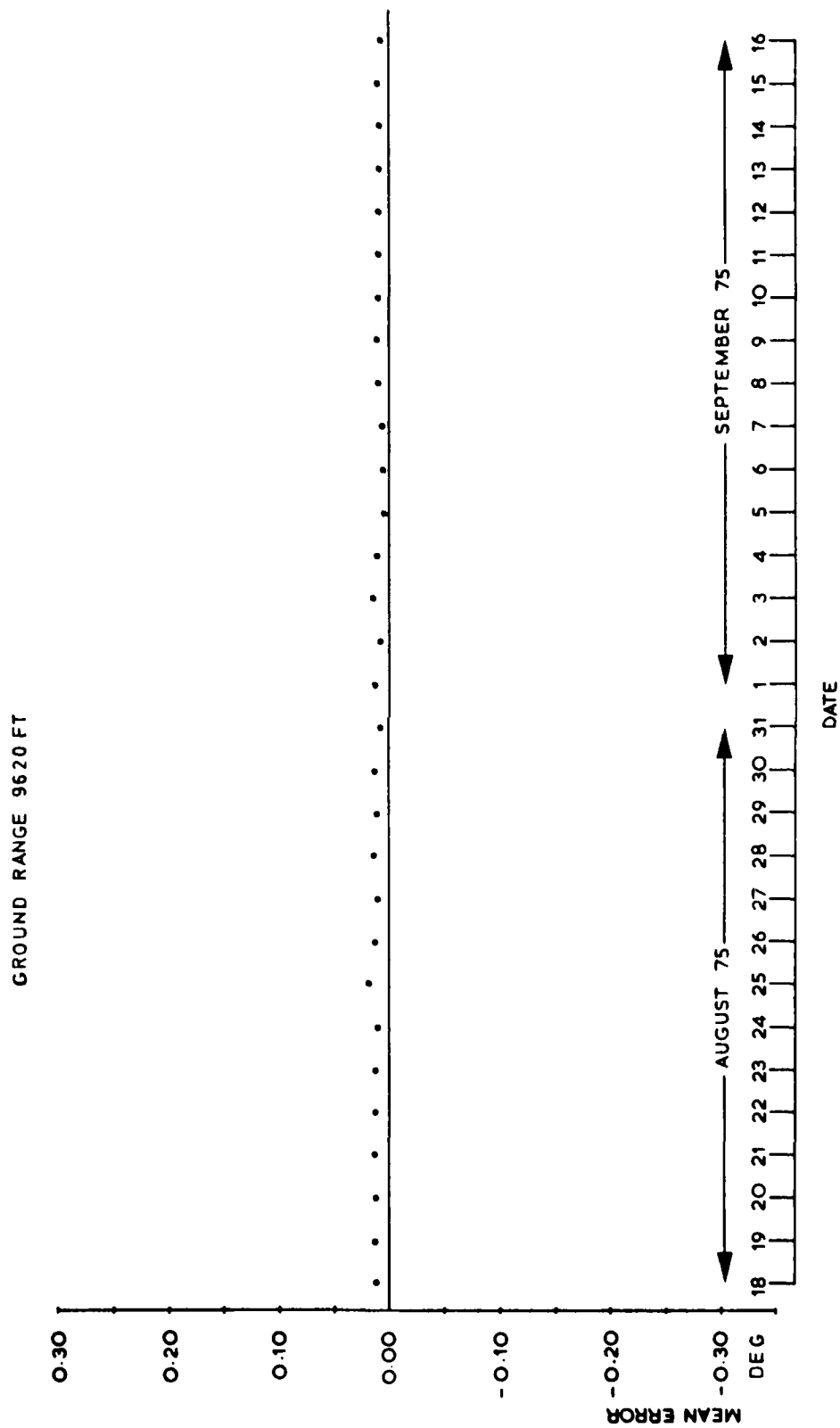


Fig 4.51

Fig 4.51 Stability test — approach mean error

Fig 4.52

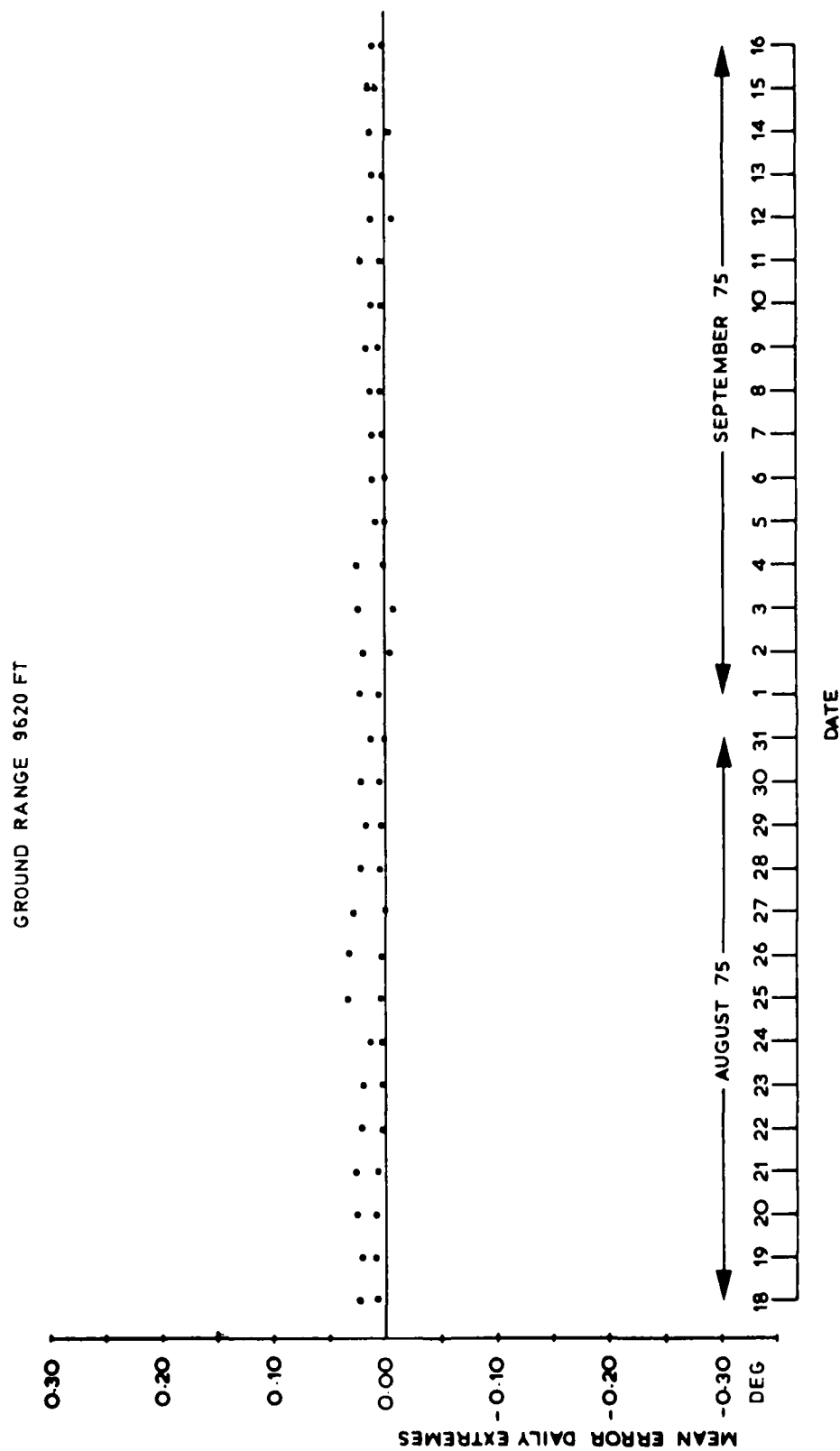


Fig 4.52 Stability test — approach azimuth daily mean error extremes

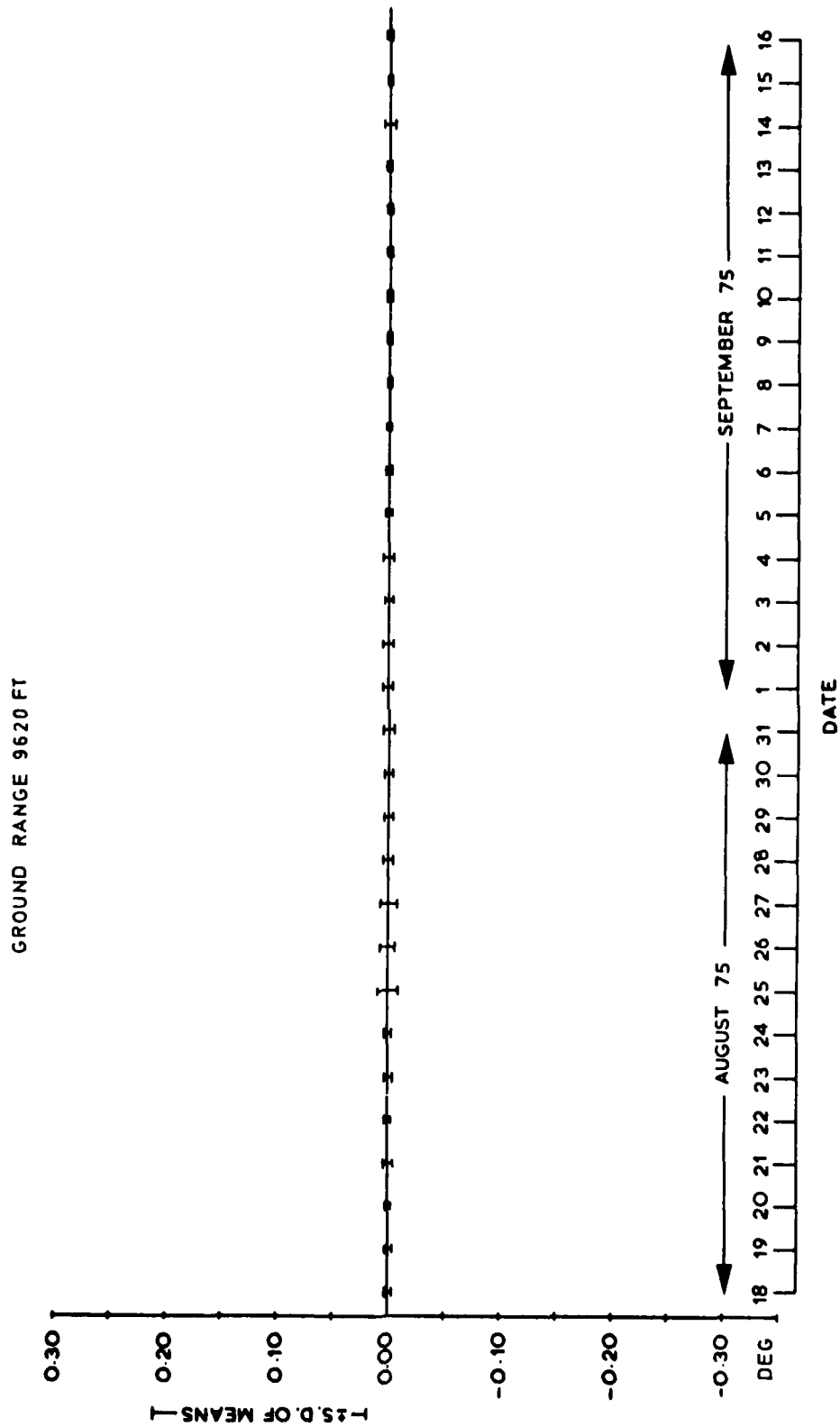


Fig 4.53 Stability test — approach azimuth daily standard deviation of means

Fig 4.54

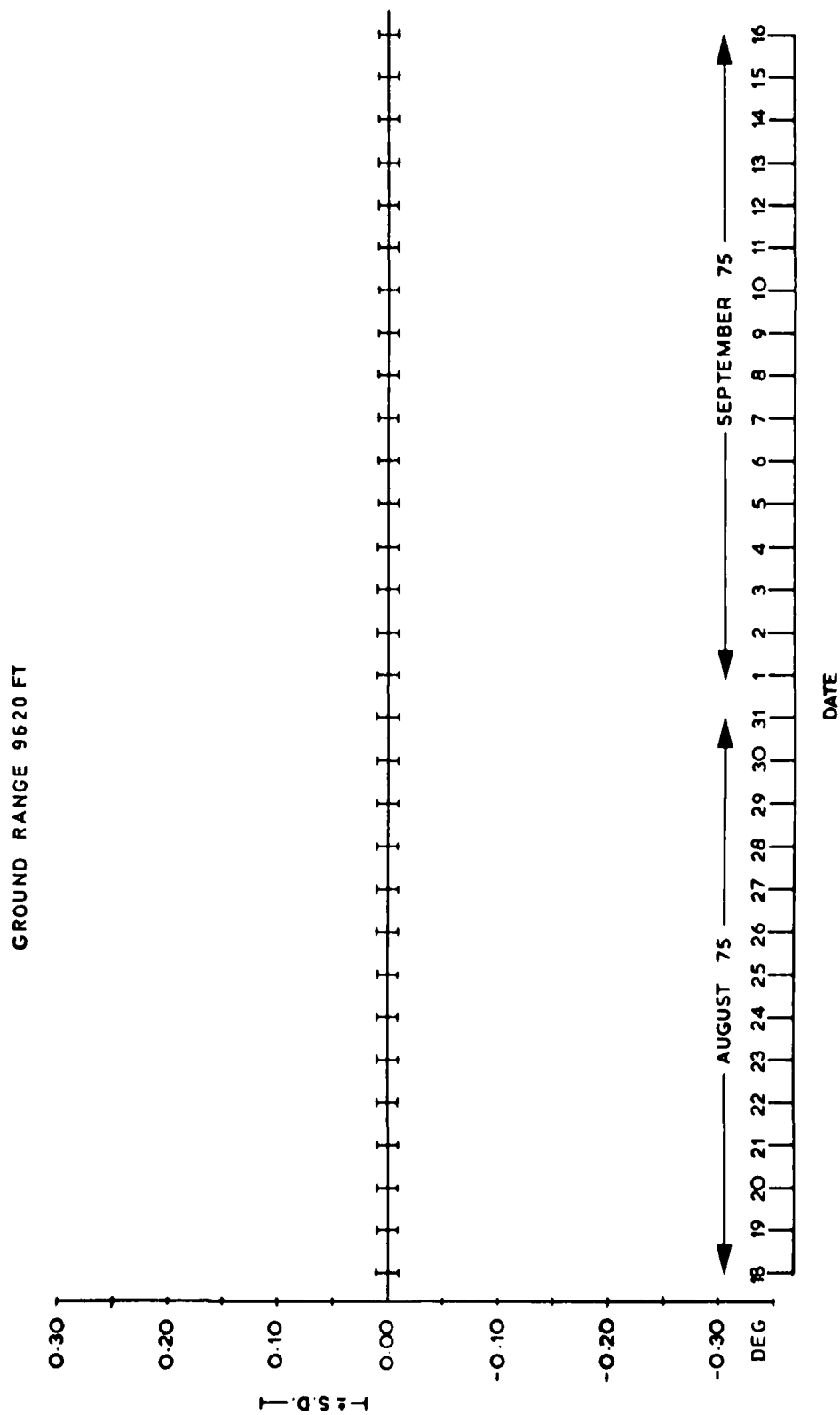


Fig 4.54 Stability test - approach azimuth noise error rms

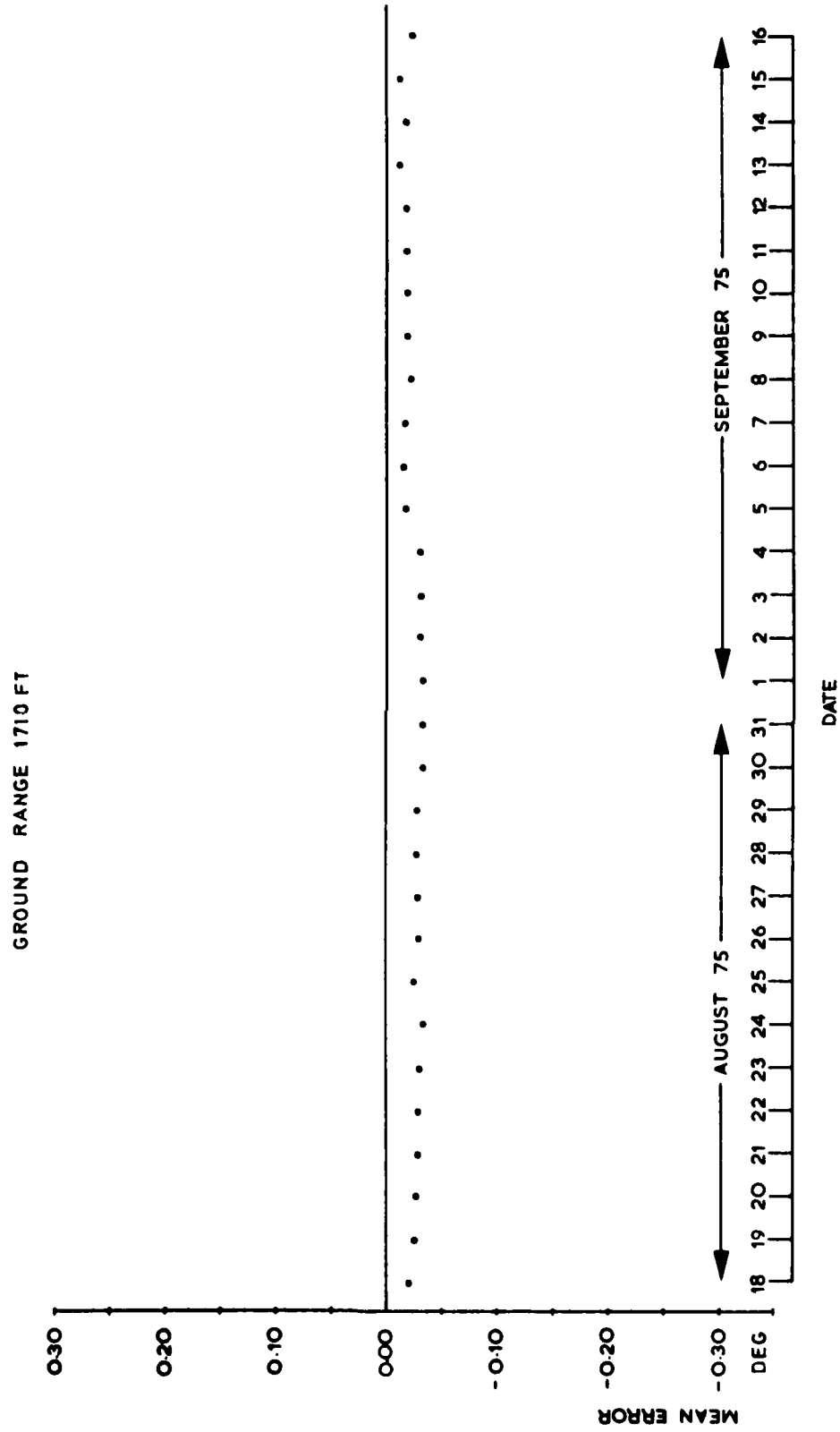


Fig 4.55

Fig 4.55 Stability test — missed approach azimuth mean error

Fig 4.56

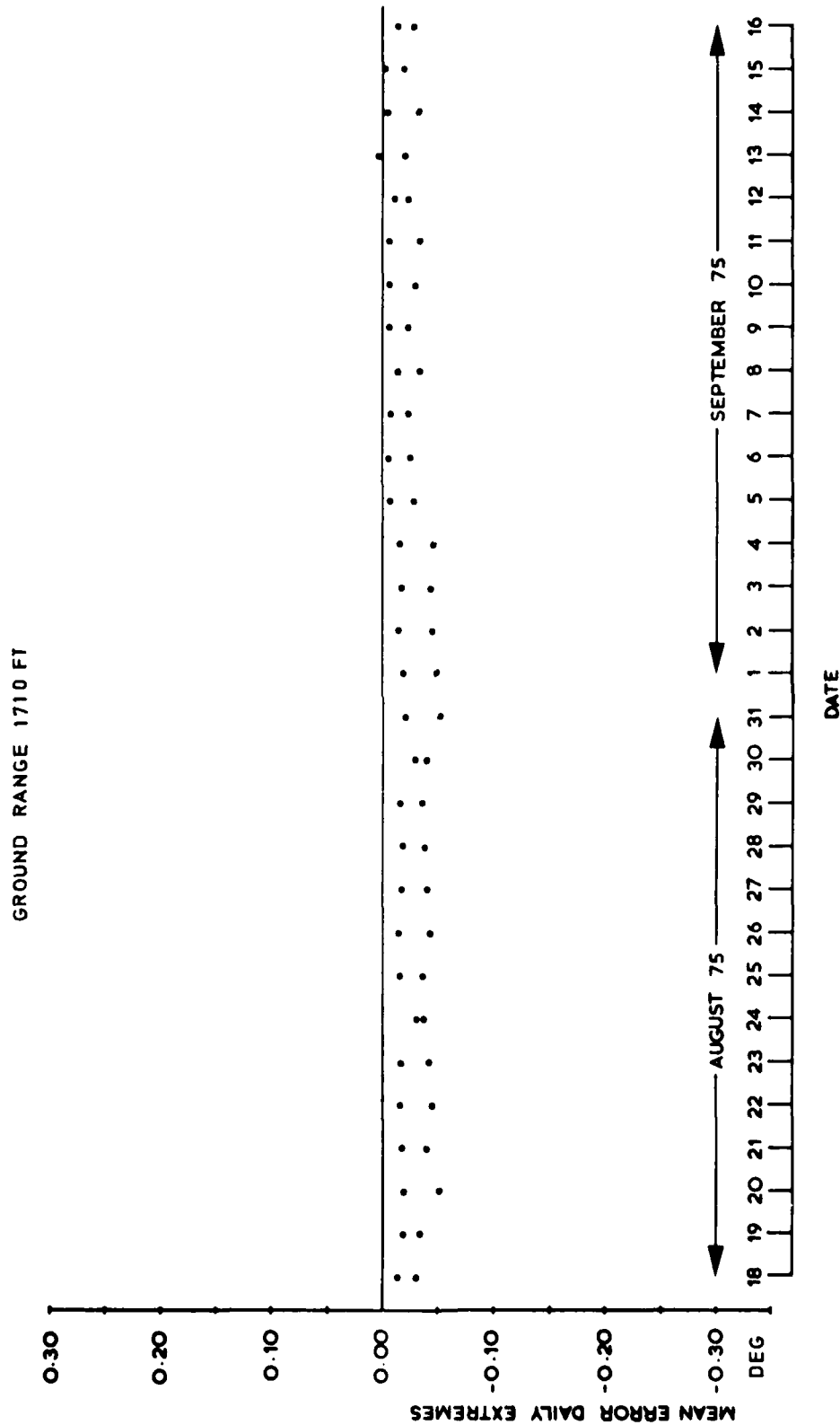


Fig 4.56 Stability test -- missed approach azimuth daily mean error extremes

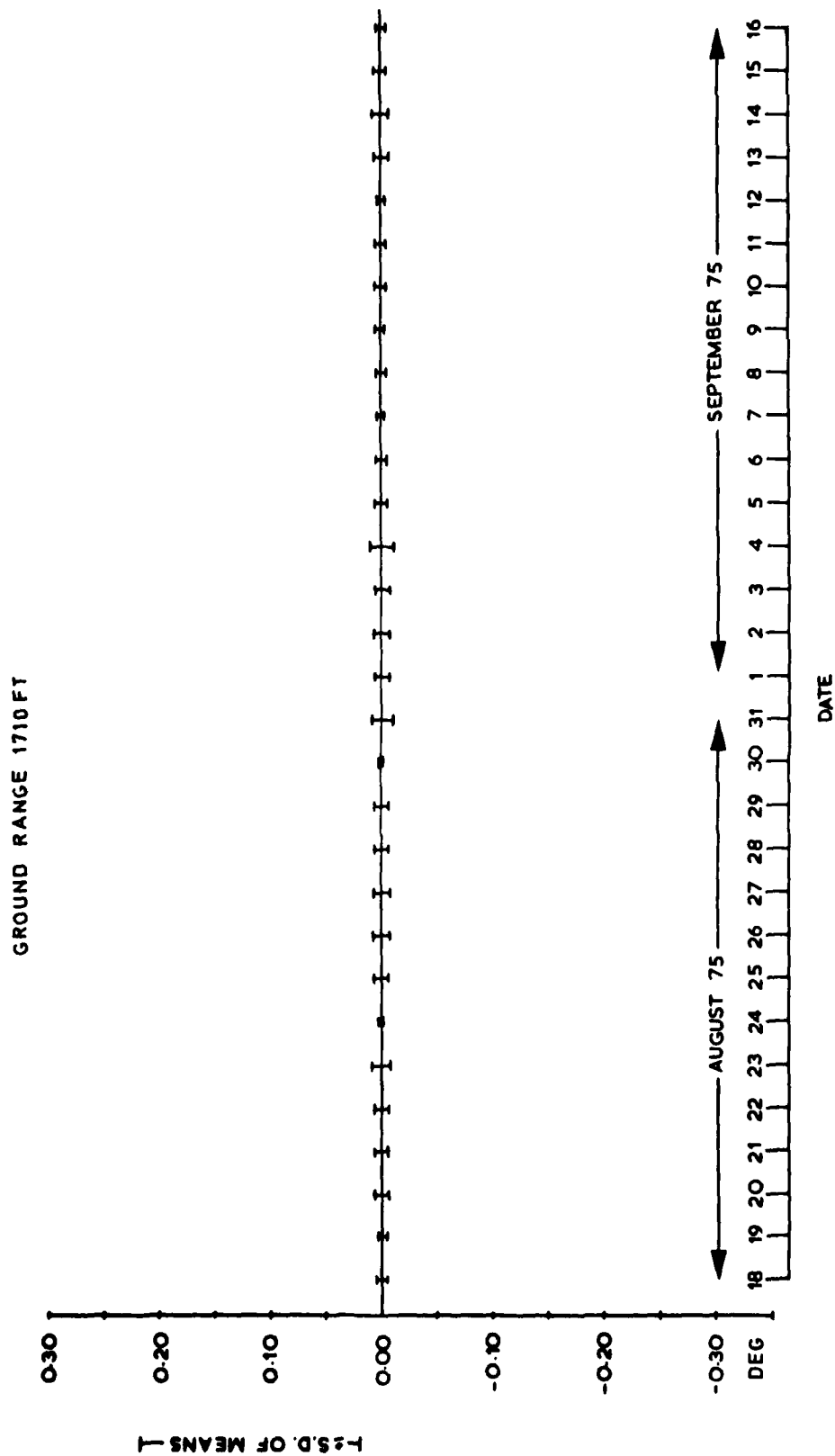


Fig 4.57

Fig 4.57 Stability test — missed approach azimuth only standard deviation of means

Fig 4.58

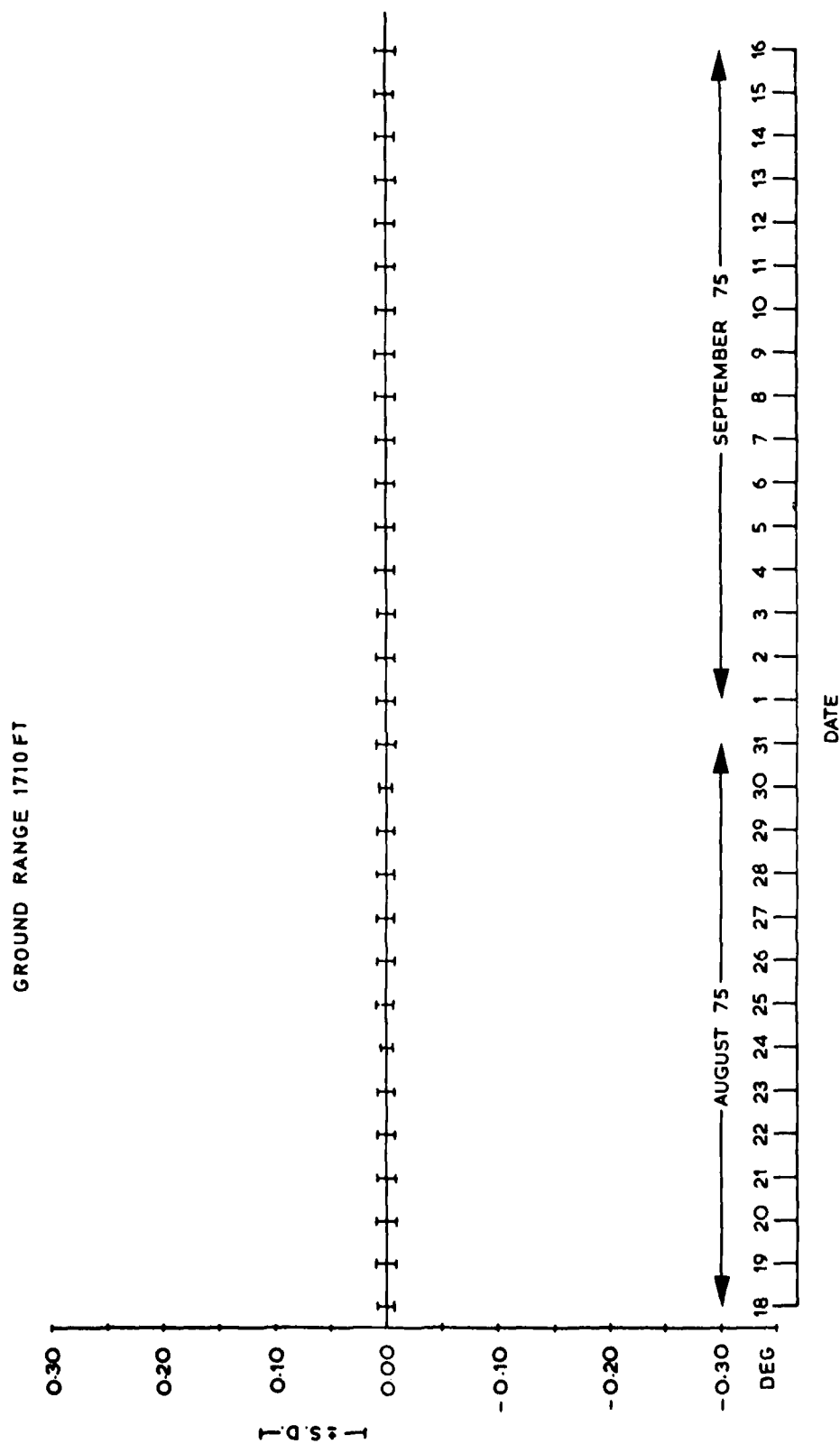


Fig 4.58 Stability test — missed approach azimuth noise error rms

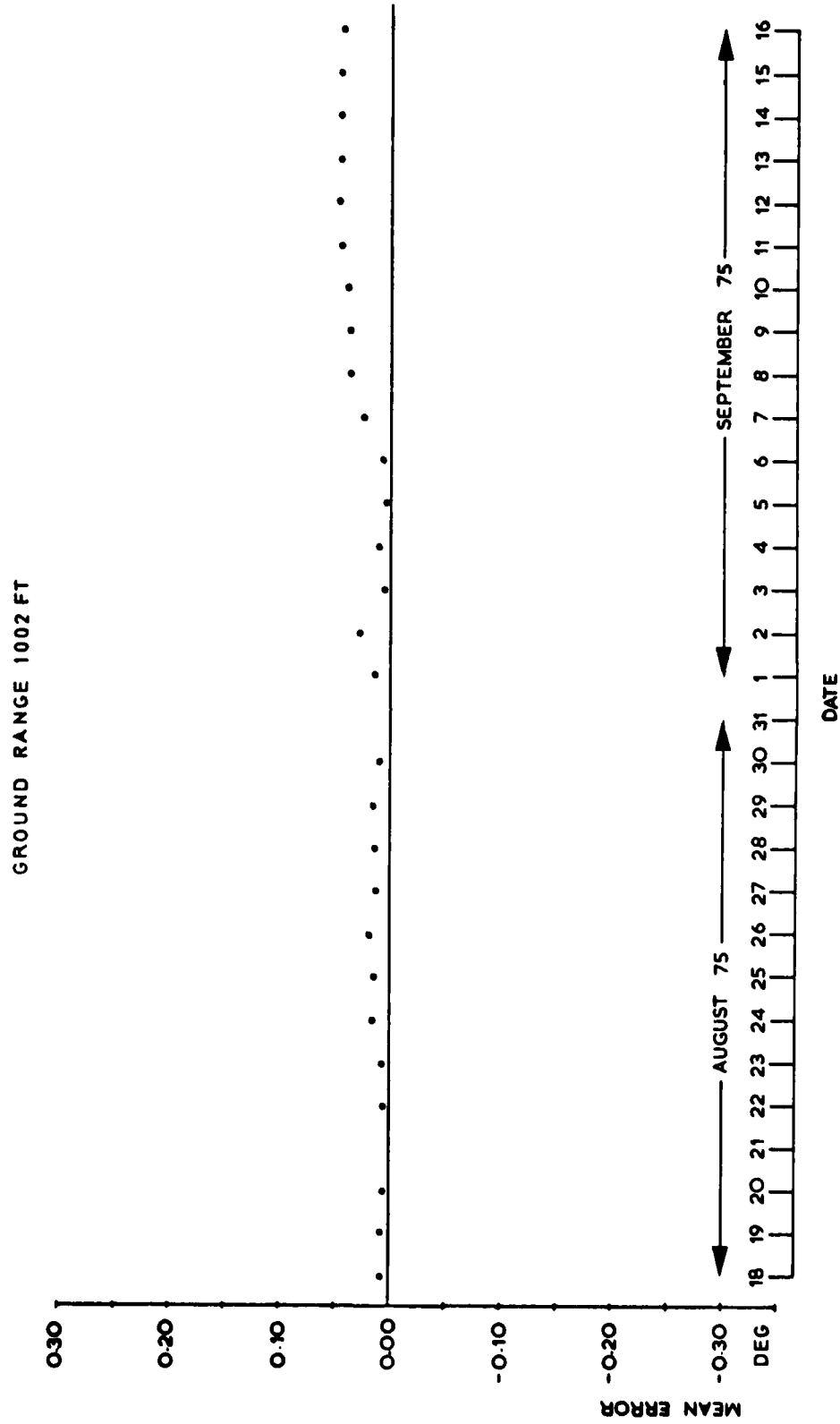


Fig 4.59

Fig 4.59 Stability test - elevation mean error

Fig 4.60

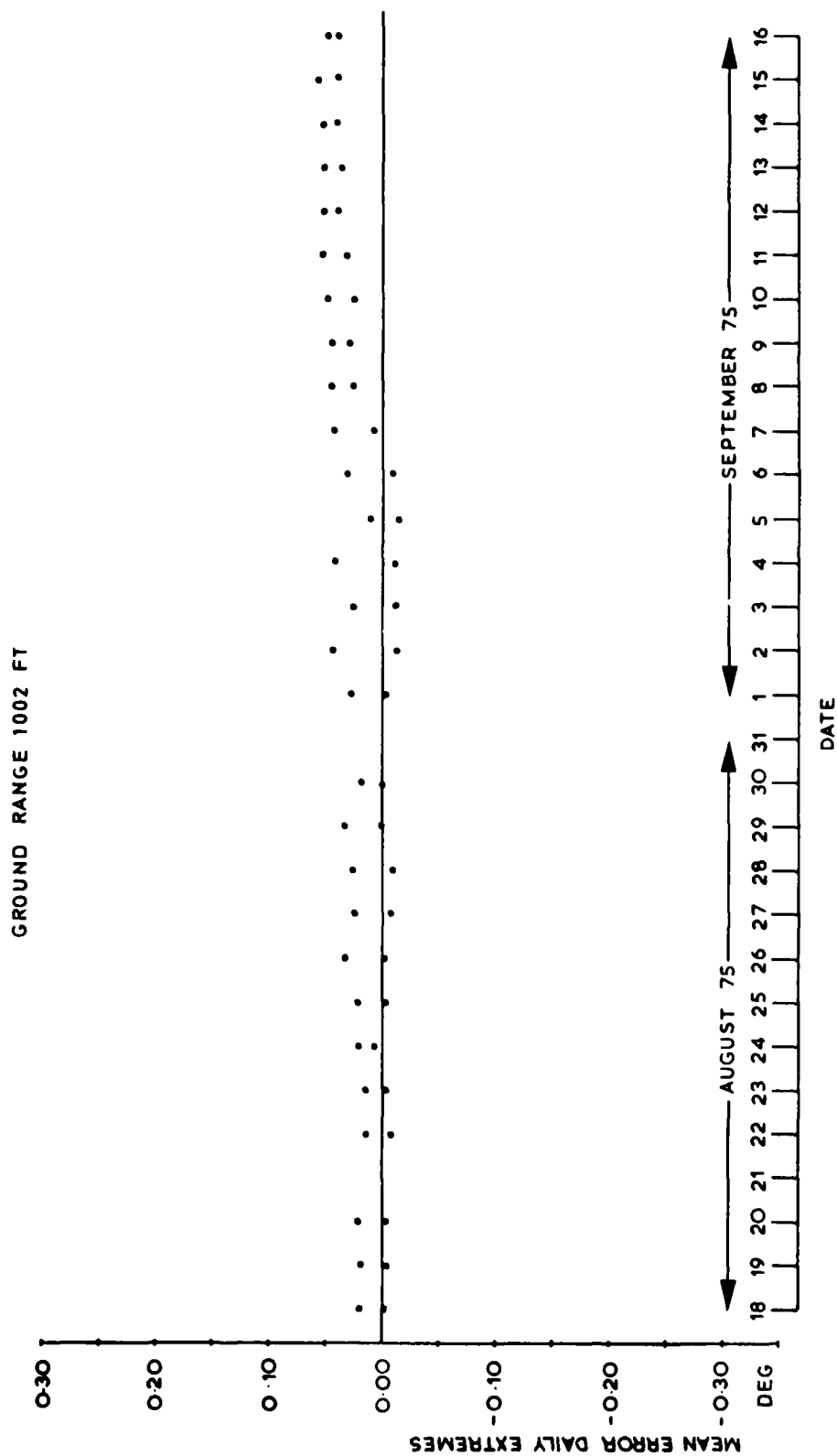


Fig 4.60 Stability test -- elevation daily mean error extremes

GROUND RANGE 1002 FT

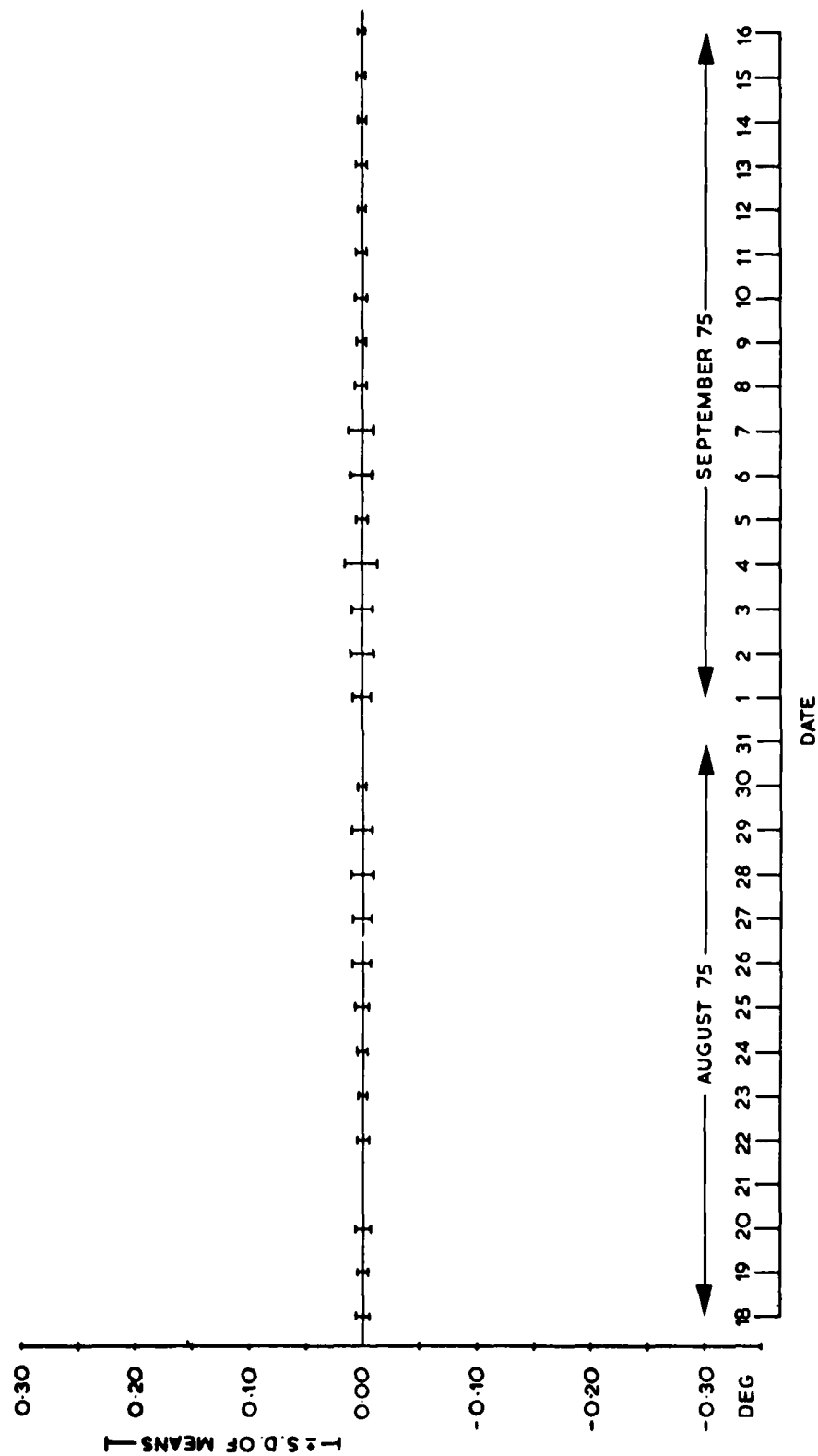


Fig 4.61

Fig 4.61 Stability test - elevation daily standard deviation of means

Fig 4.62

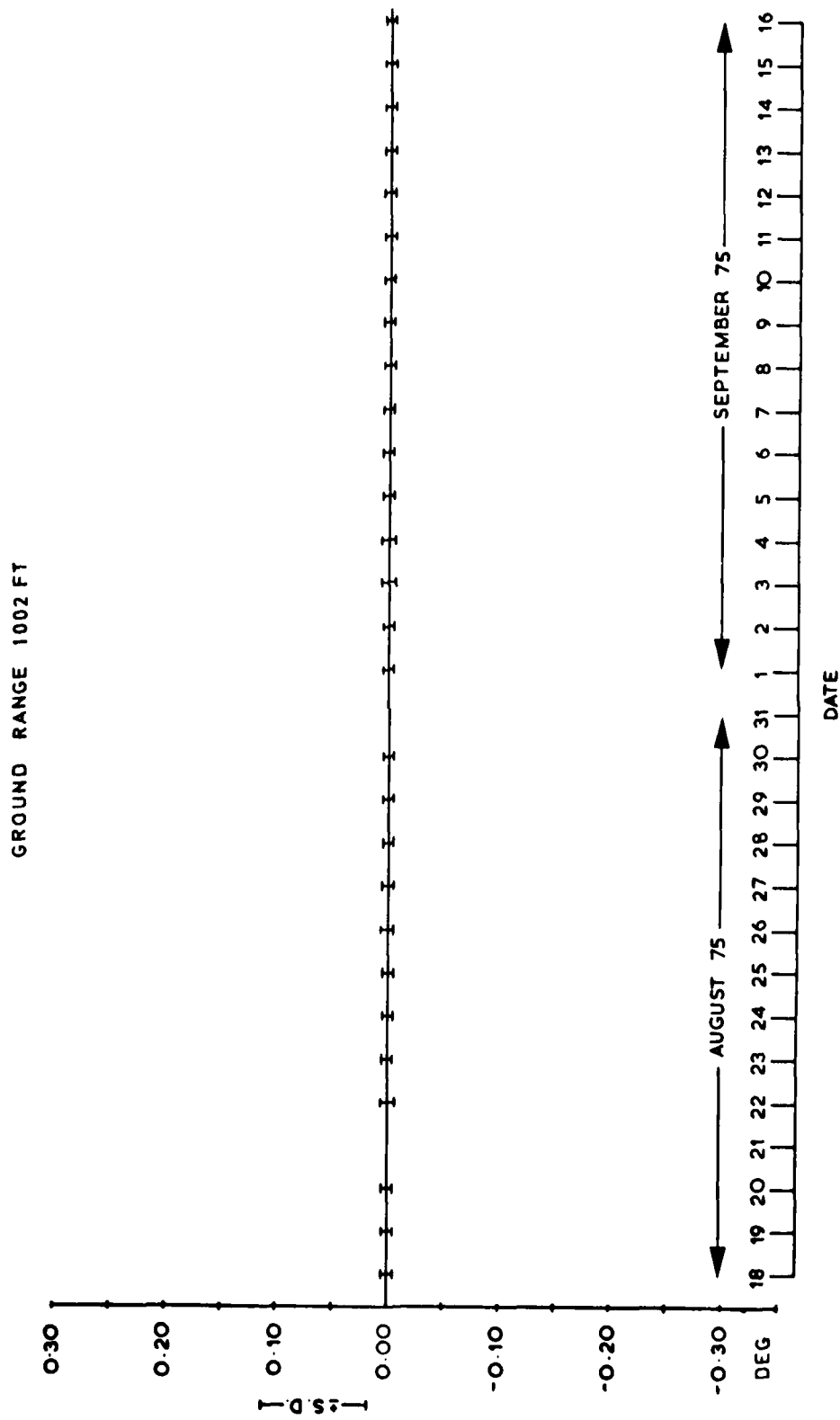


Fig 4.62 Stability test — elevation noise error rms

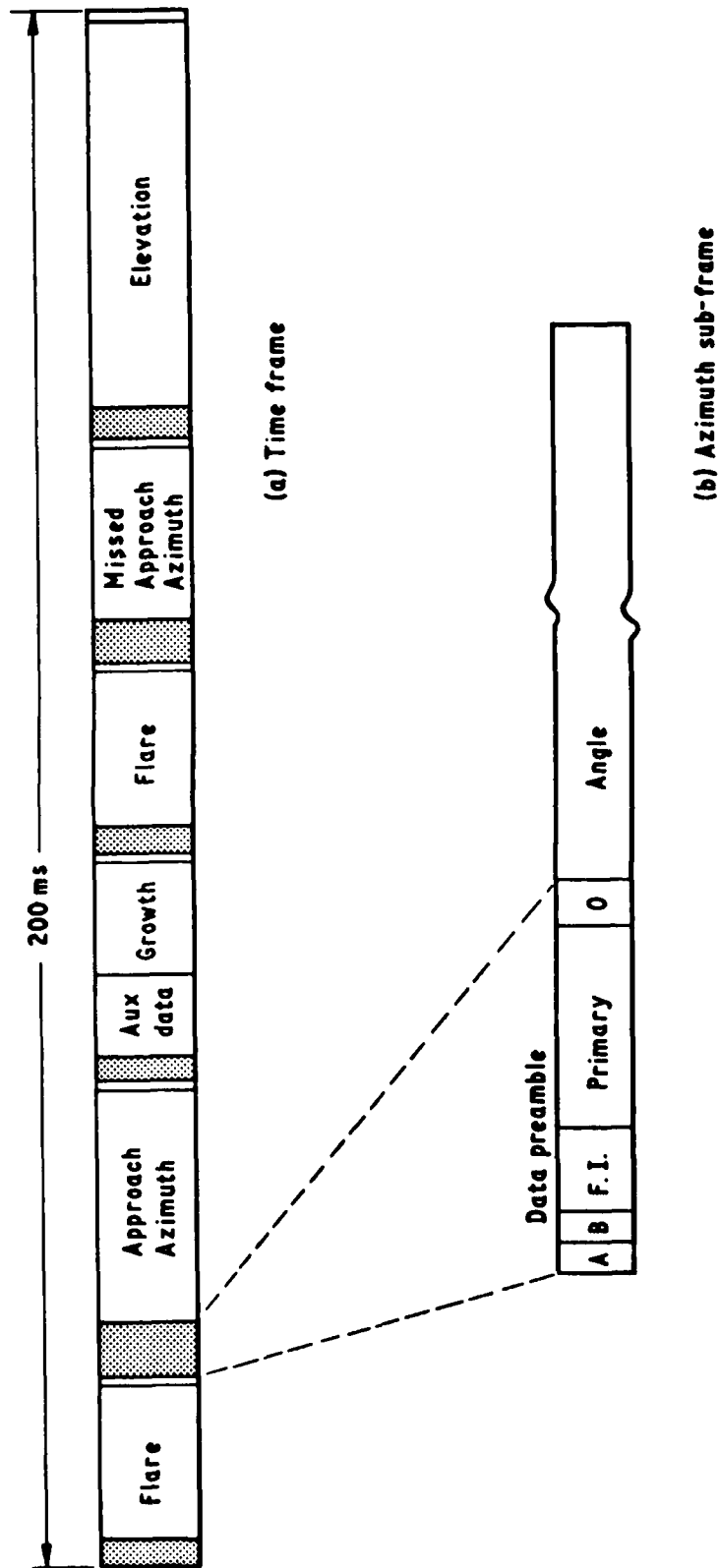


Fig 5.1 TDM signal format

Fig 5.2

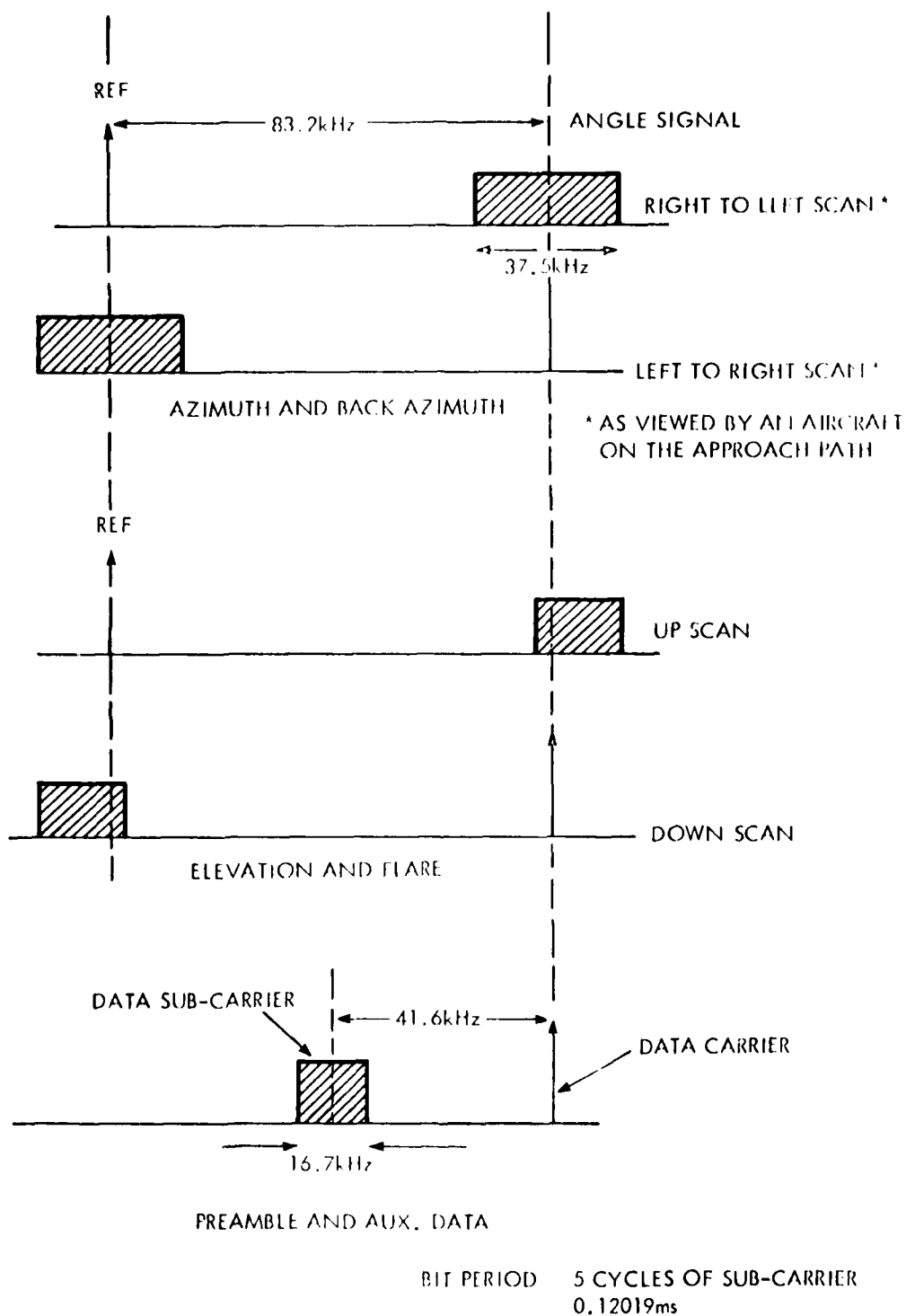


Fig 5.2 Relative frequencies of the angle and data components of the system

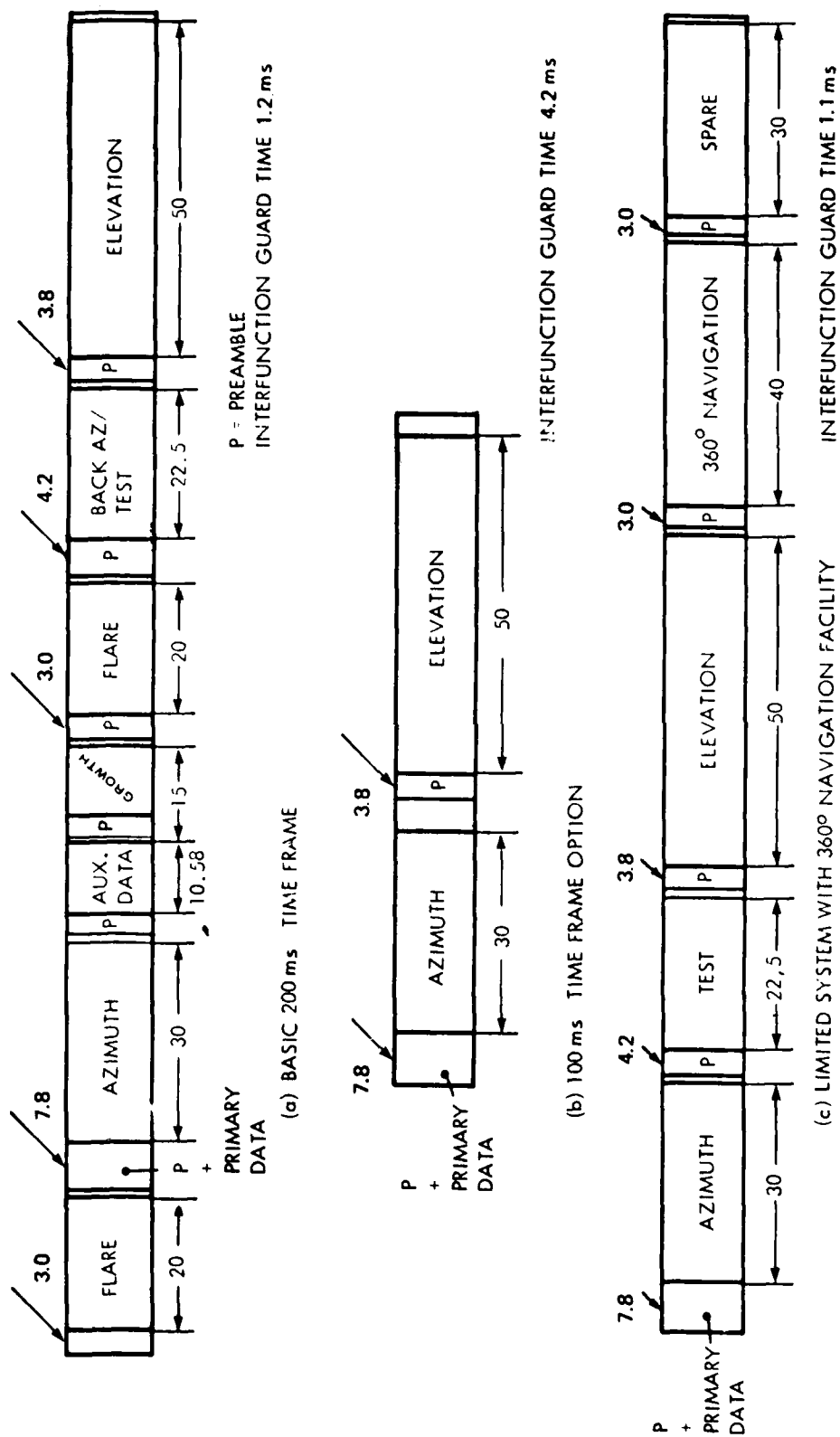
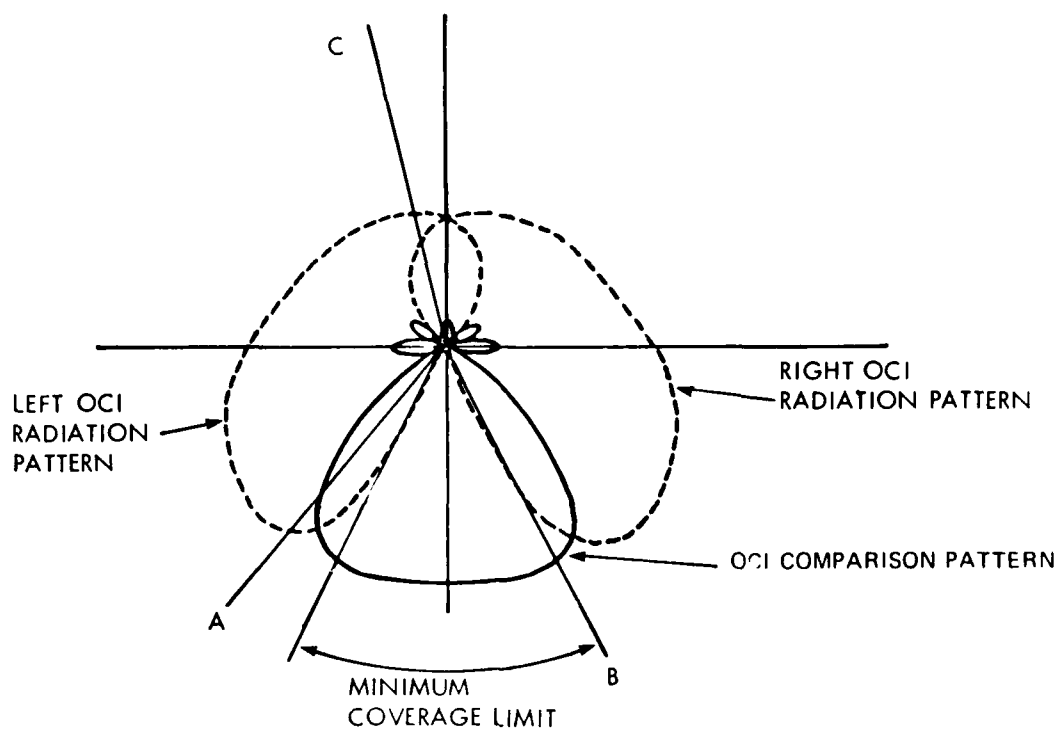


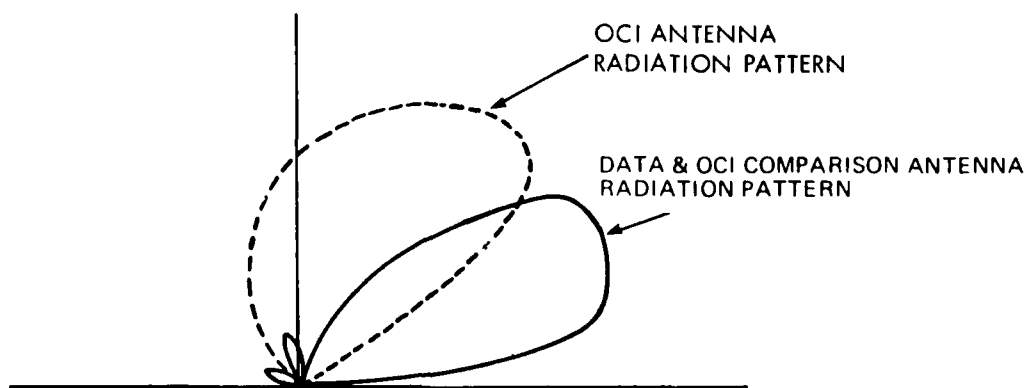
Fig 5.3

Fig 5.3 Time frame arrangement (major alternatives)

Fig 5.4



(a) AZIMUTH SYSTEM - AZIMUTH COVERAGE PATTERN



(b) ELEVATION SYSTEM - ELEVATION COVERAGE PATTERN

Fig 5.4 OCI antenna patterns

Fig 5.5

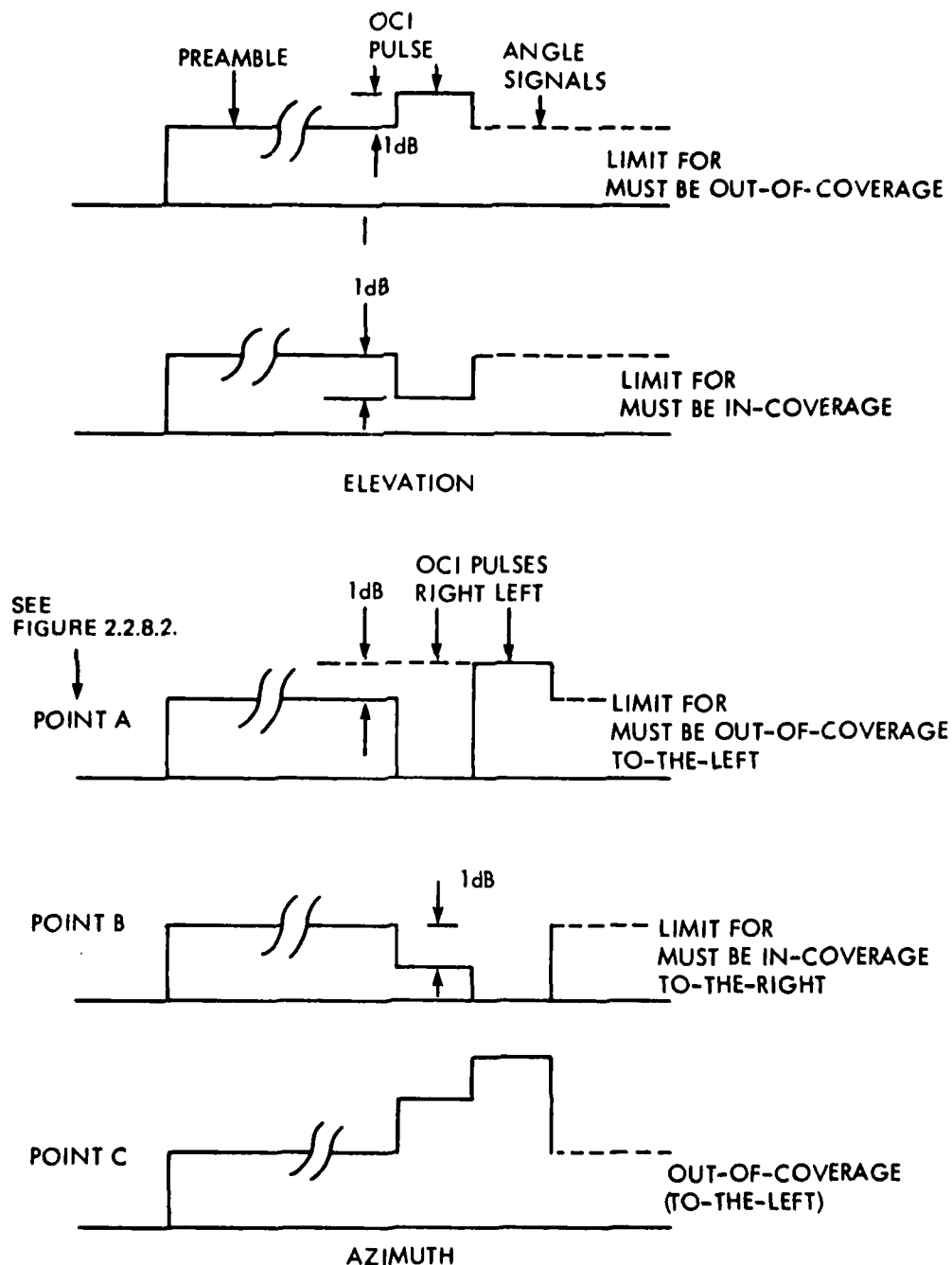


Fig 5.5 OCI limits (as seen by the aircraft)

Fig 5.6

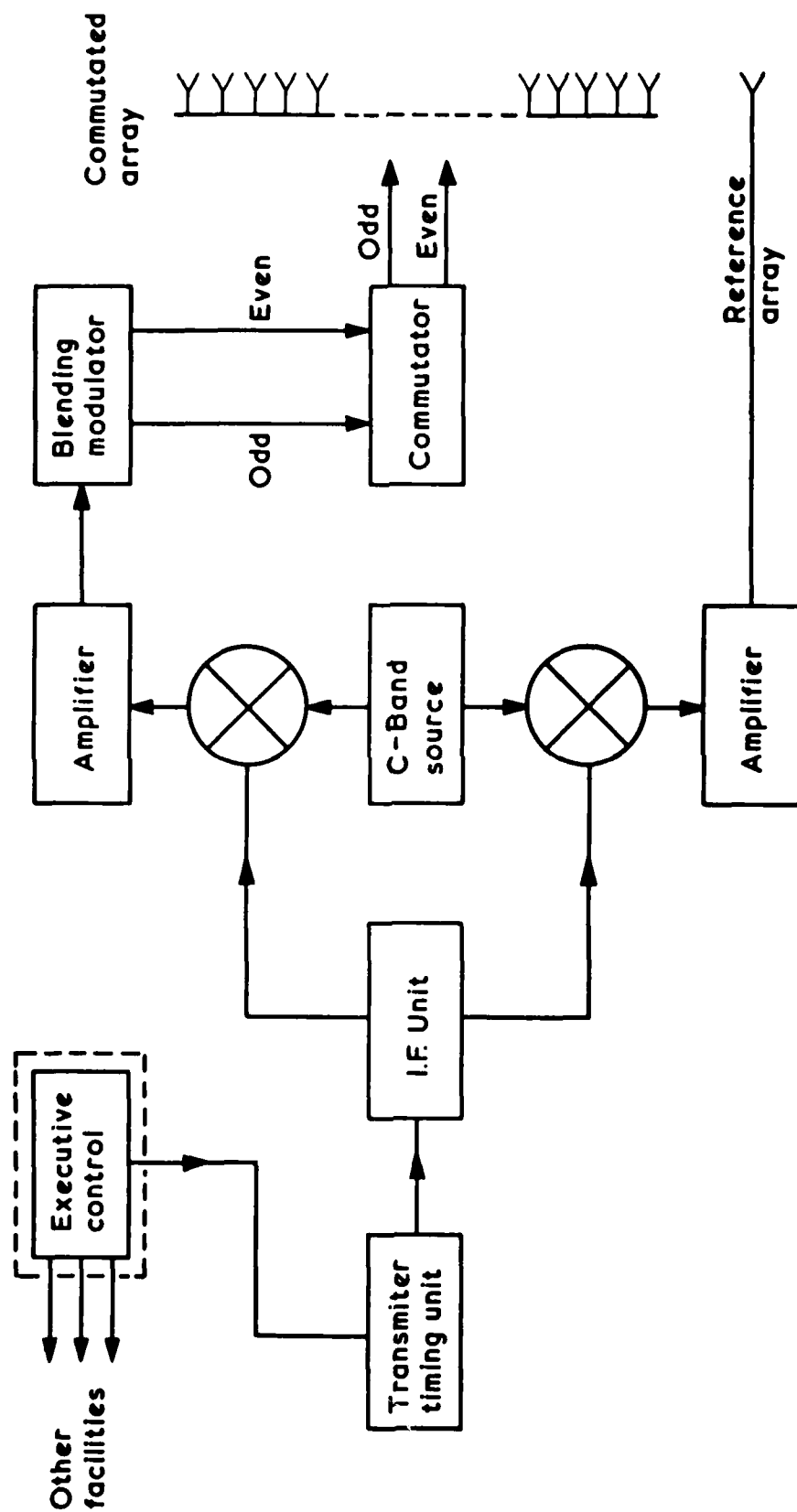


Fig 5.6 Typical ground facility

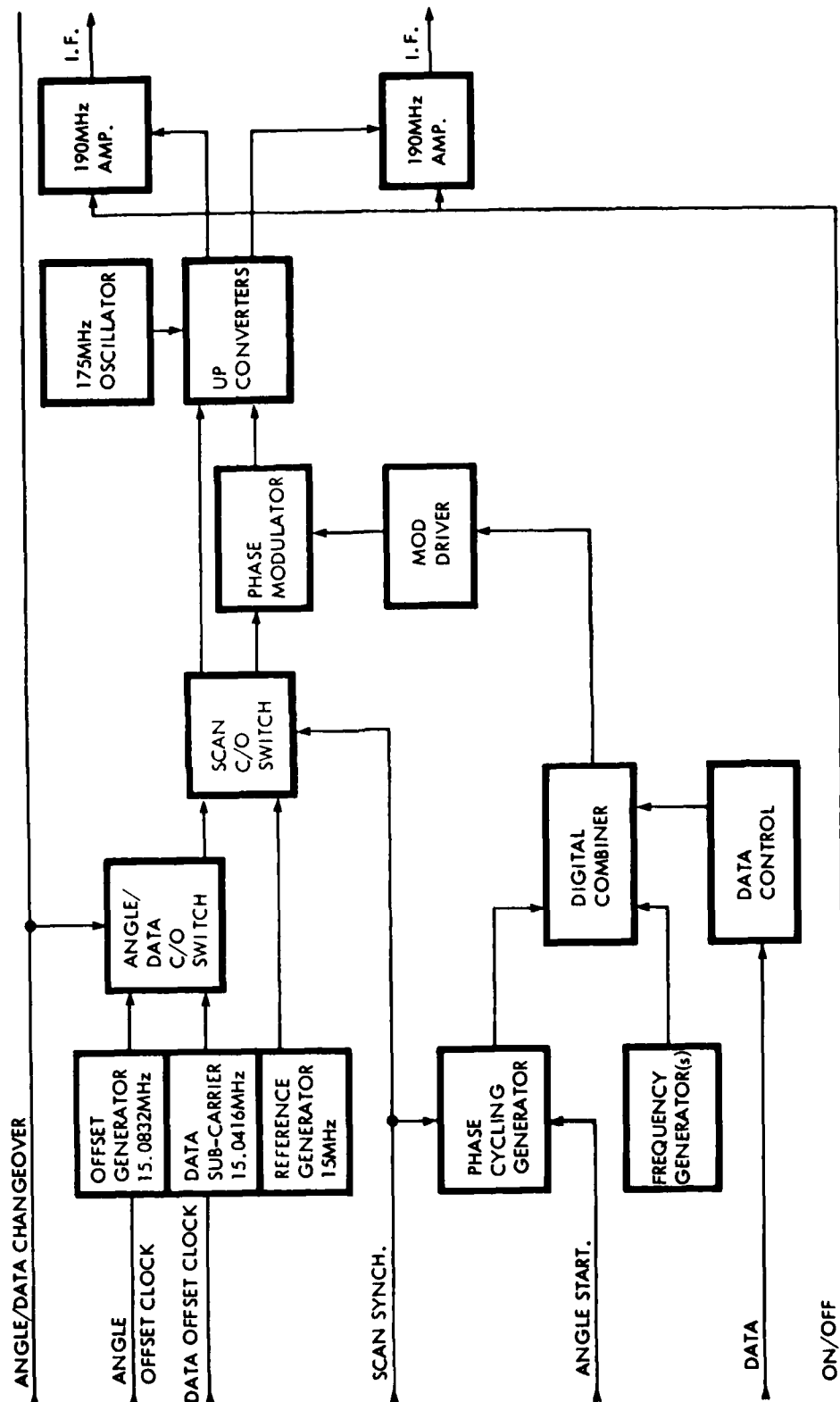


Fig 5.7

Fig 5.7 Transmitter IF unit

Fig 5.8

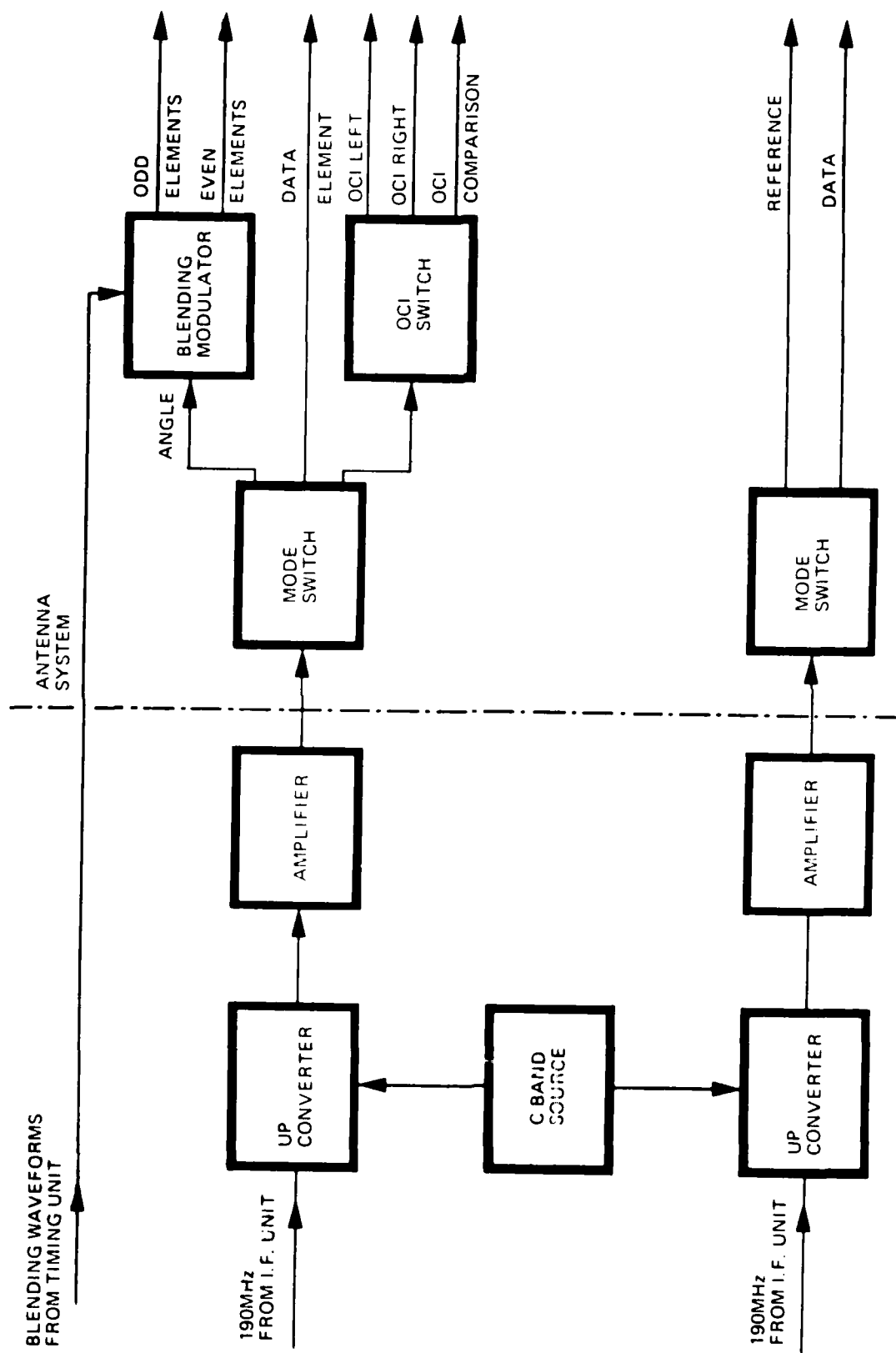


Fig 5.8 Transmitter and antenna RF

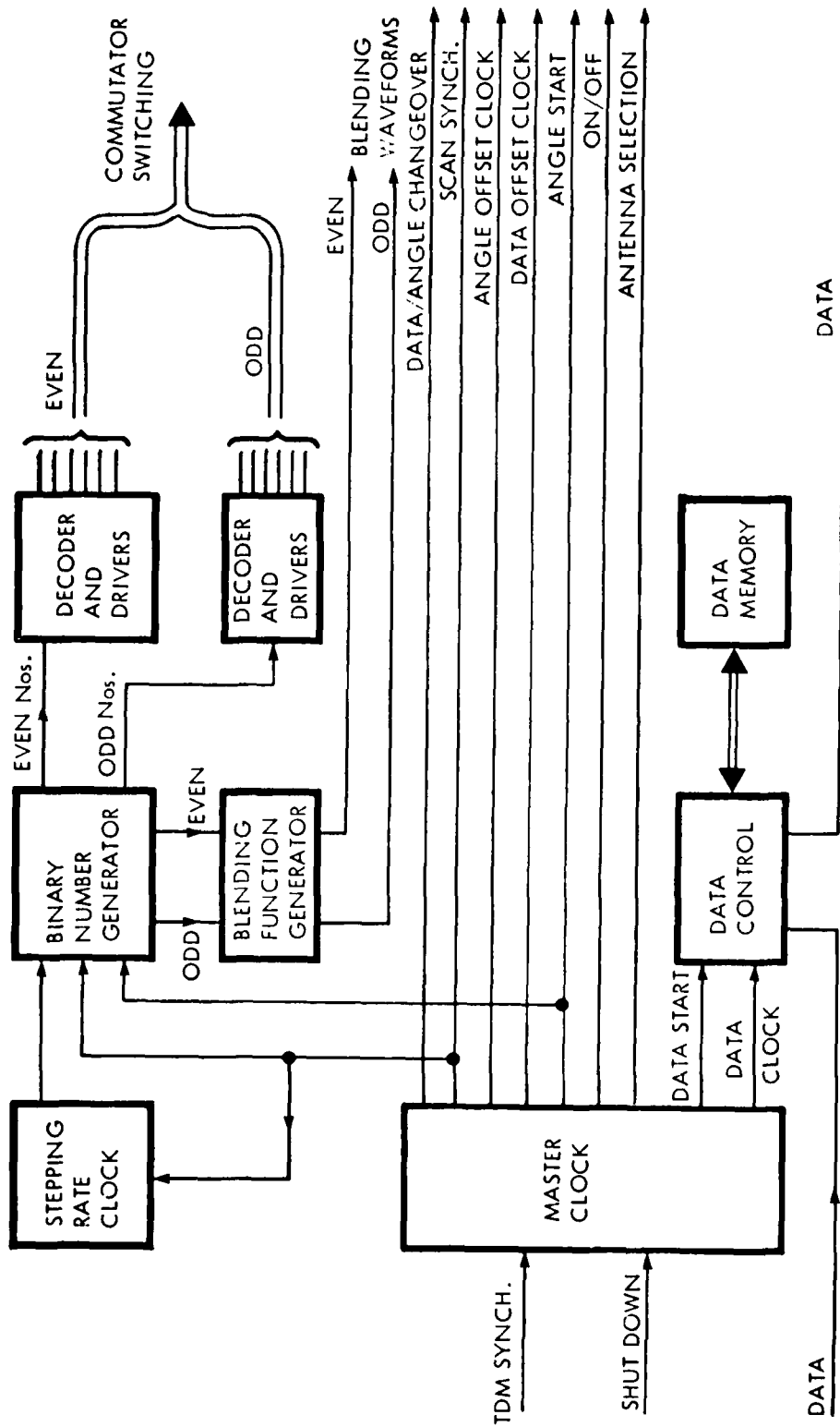


Fig 5.9

Fig 5.9 Transmitter timing unit

Fig 5.10

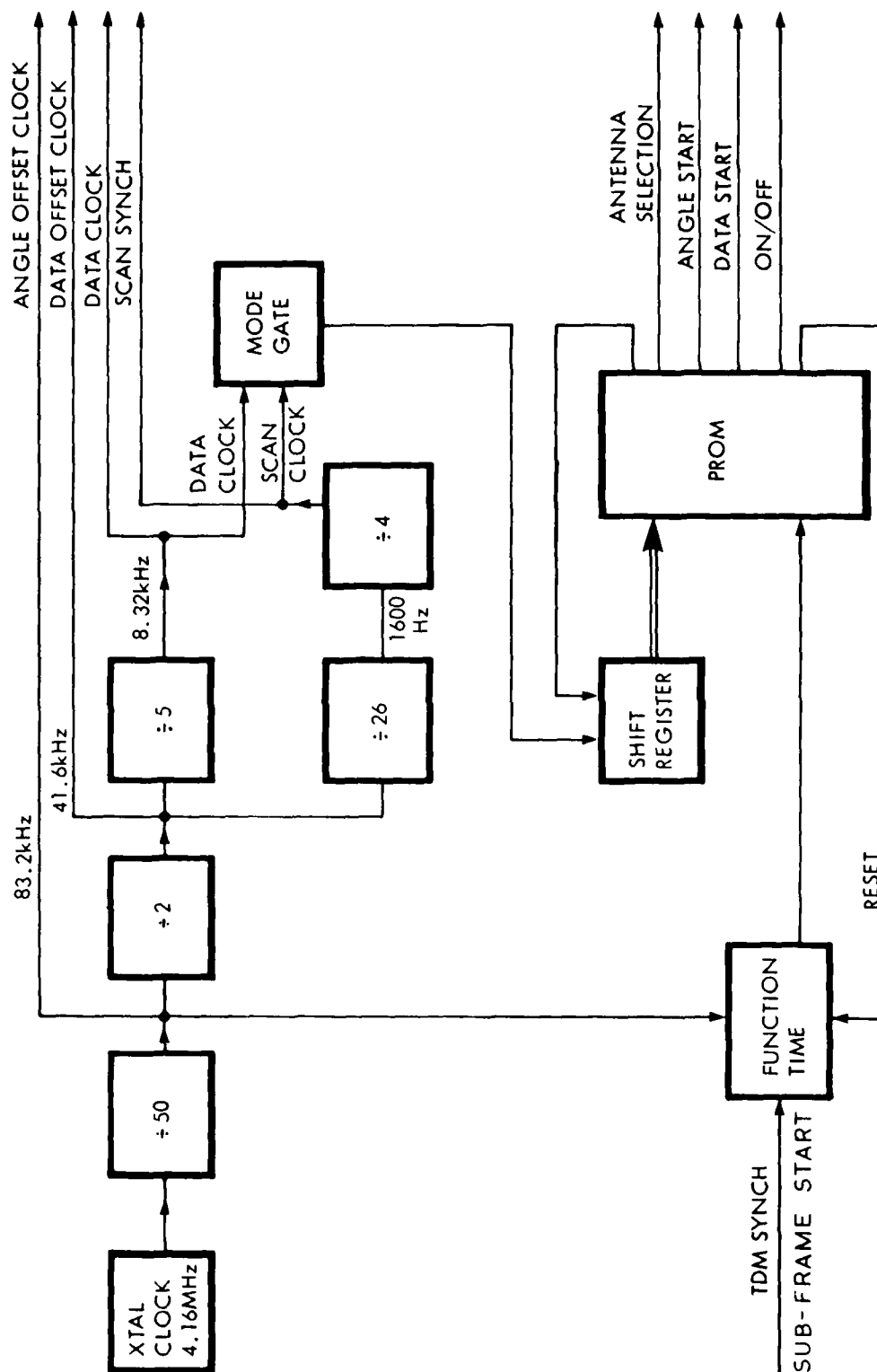


Fig 5.10 Master clock

Fig 5.11

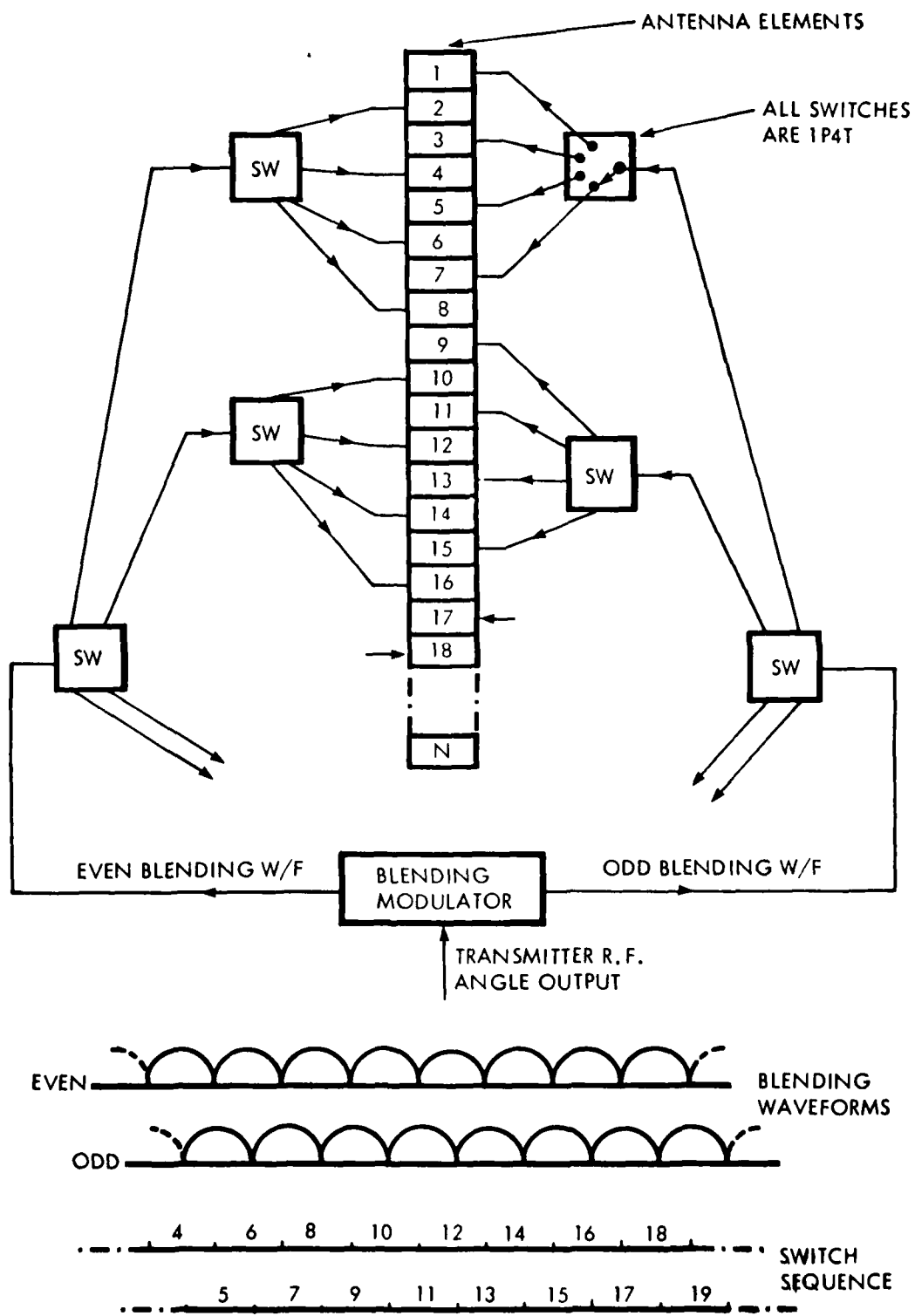


Fig 5.11 Commutator switching

Fig 5.12

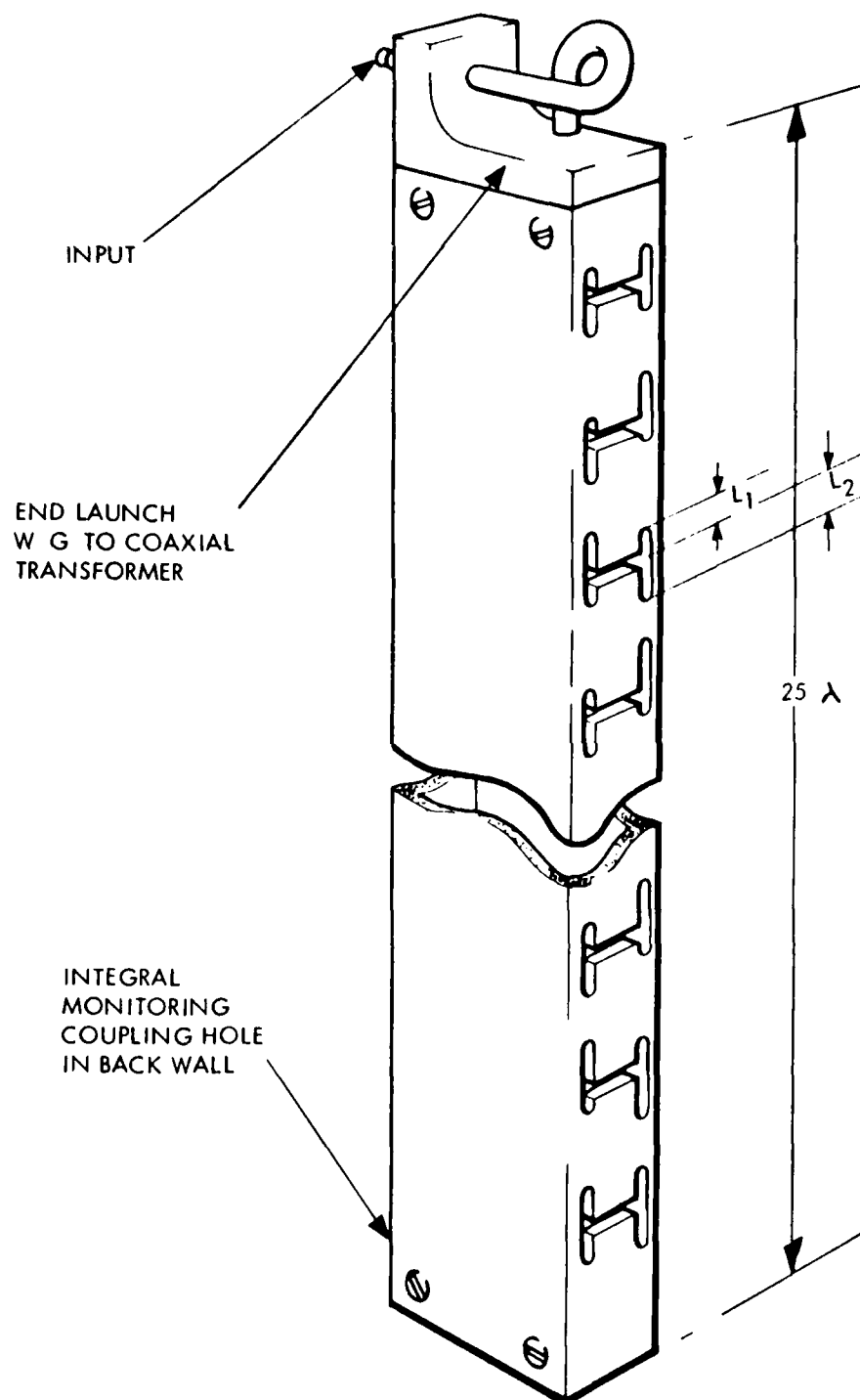


Fig 5.12 Azimuth vertical column element

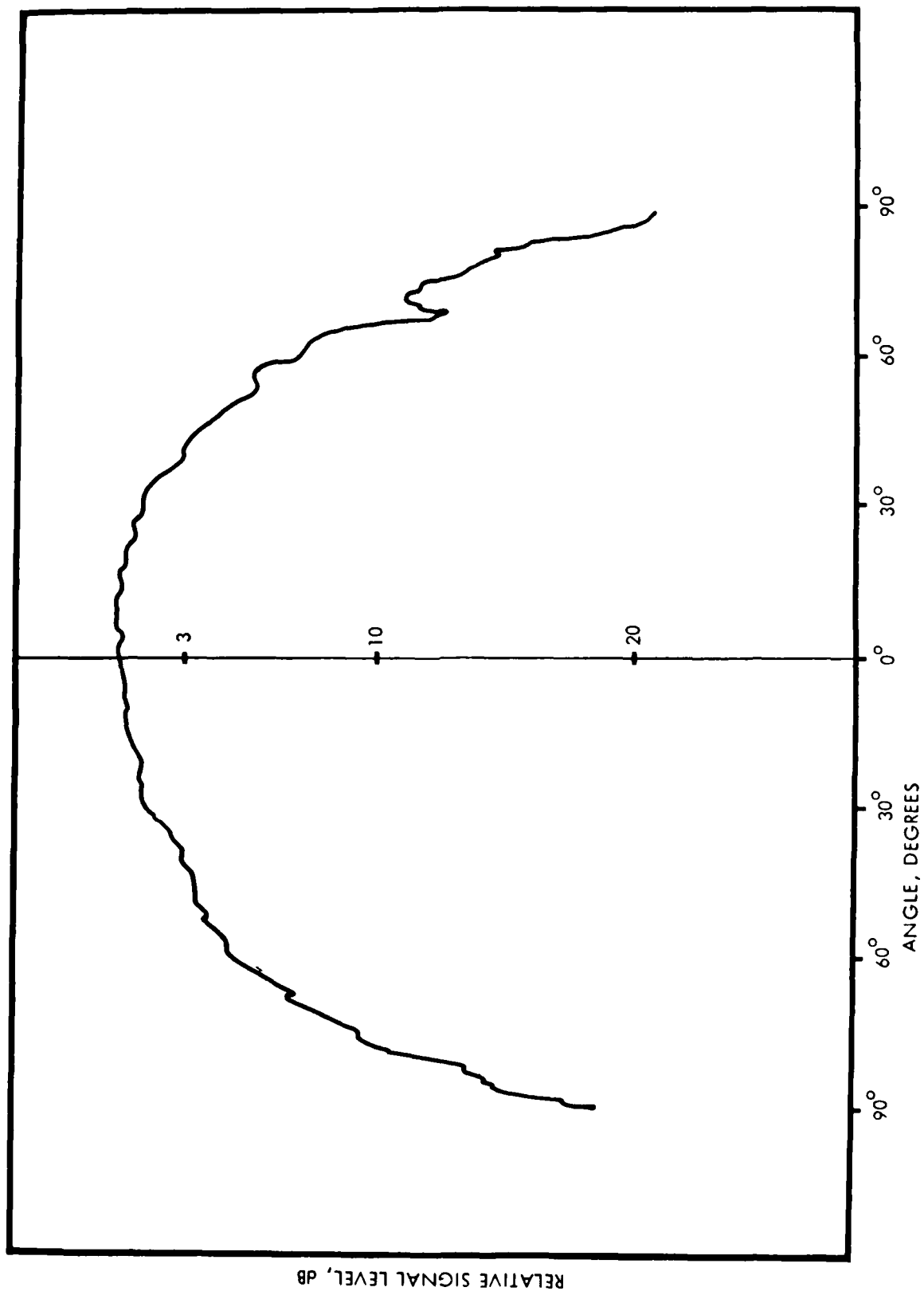


Fig 5.13 Azimuth array — typical azimuth radiation pattern

Fig 5.14

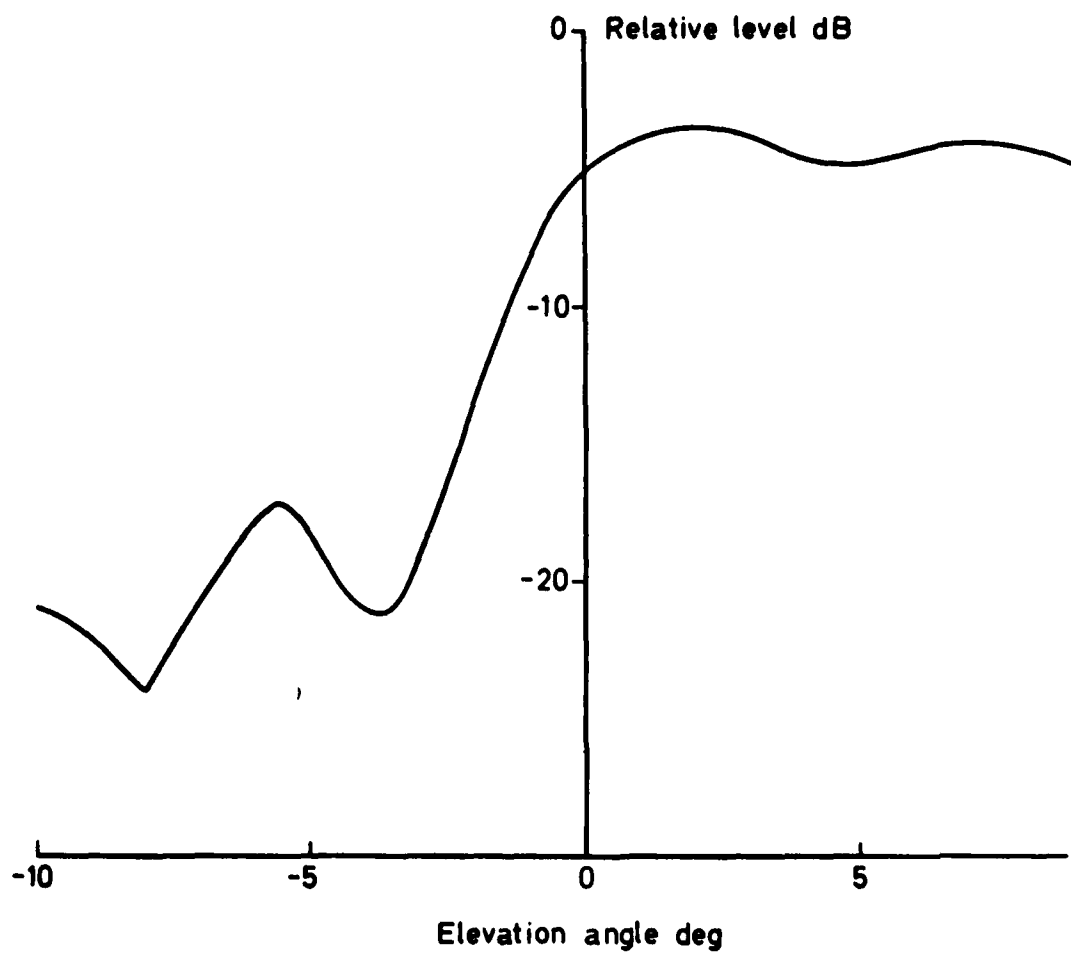


Fig 5.14 Column element typical vertical radiation pattern

Fig 5.15

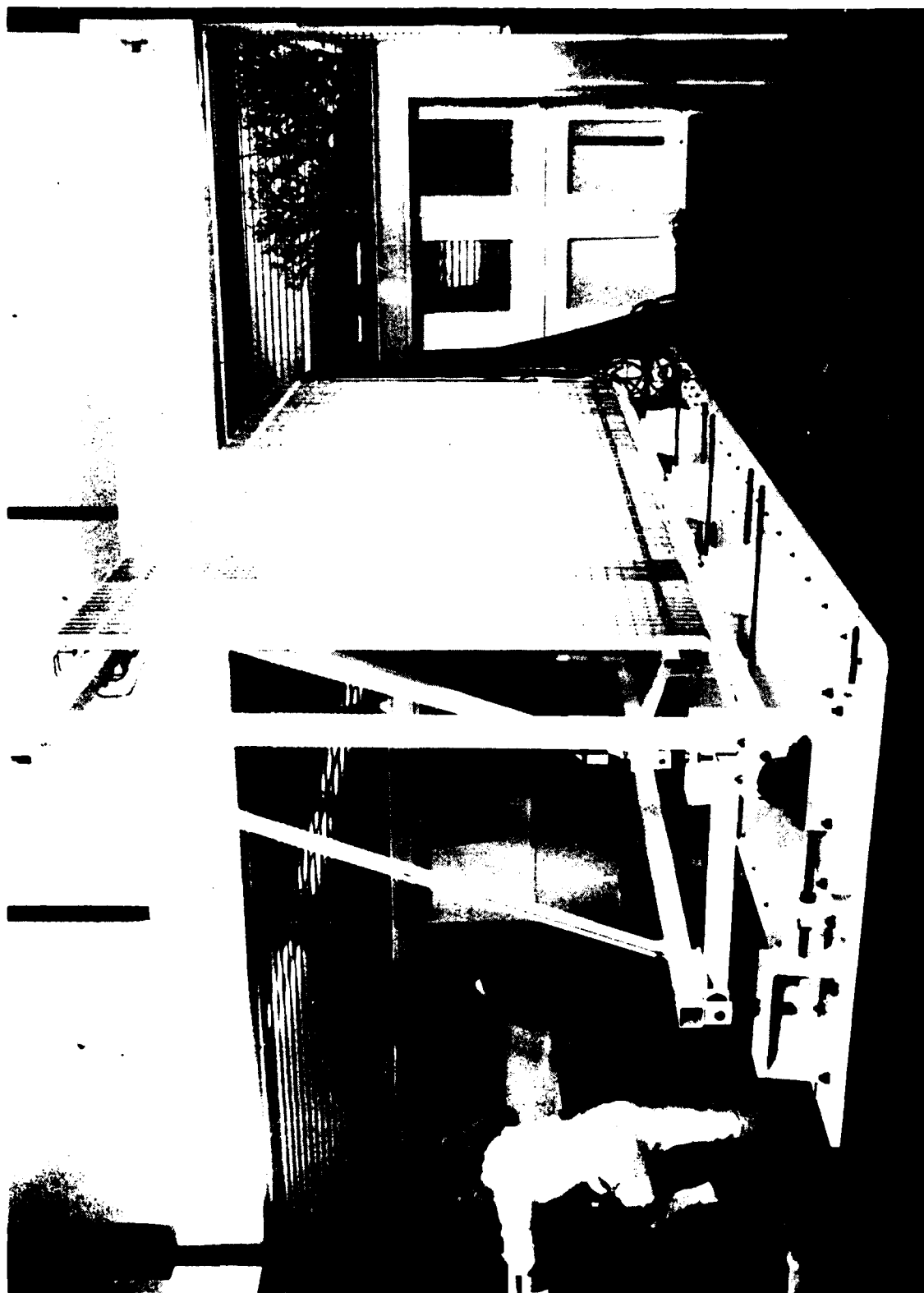


Fig 5.15 Azimuth array showing slotted columns and support frame

Fig 5.16

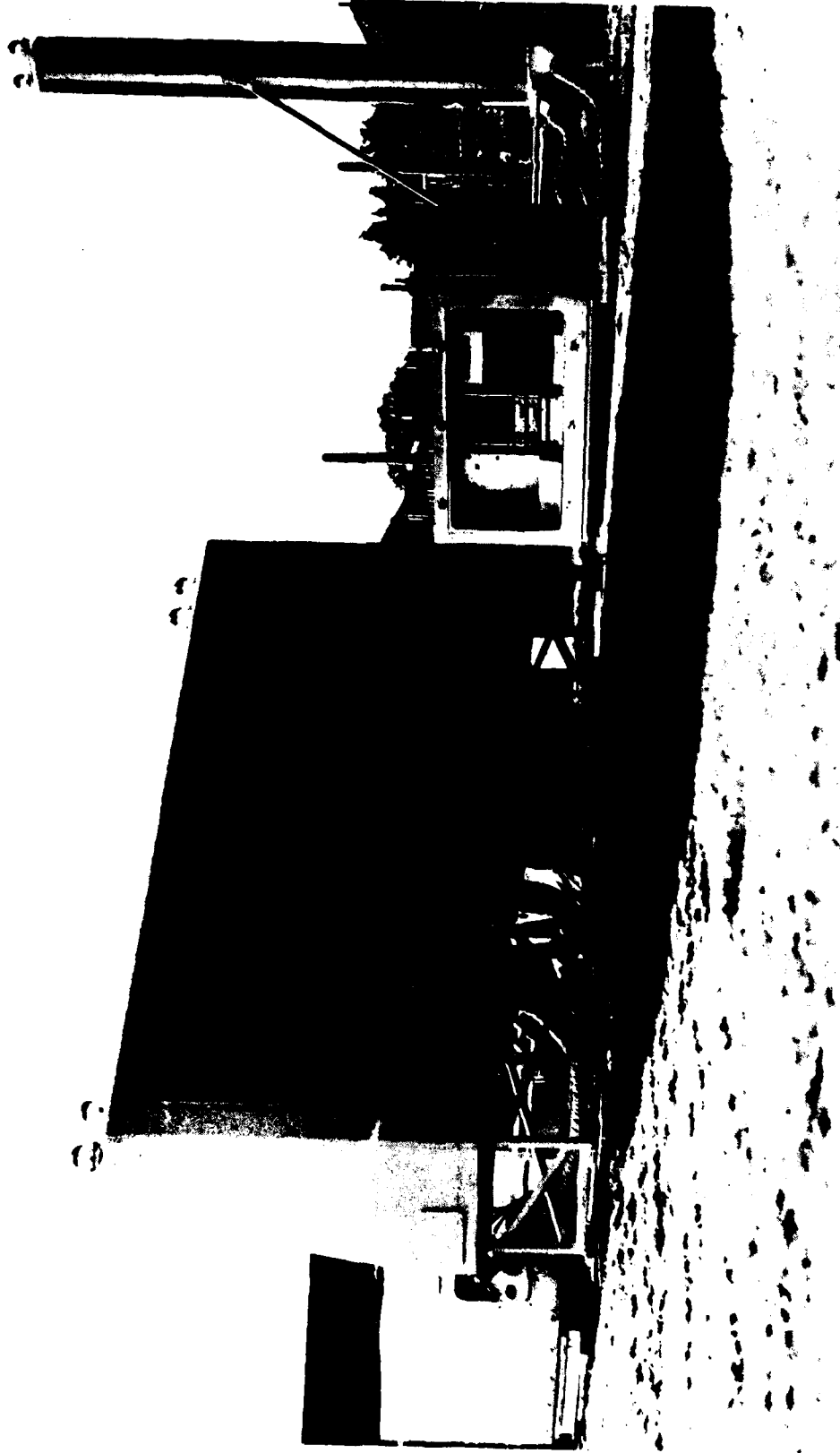


Fig 5.16 Collocated elevation and azimuth arrays

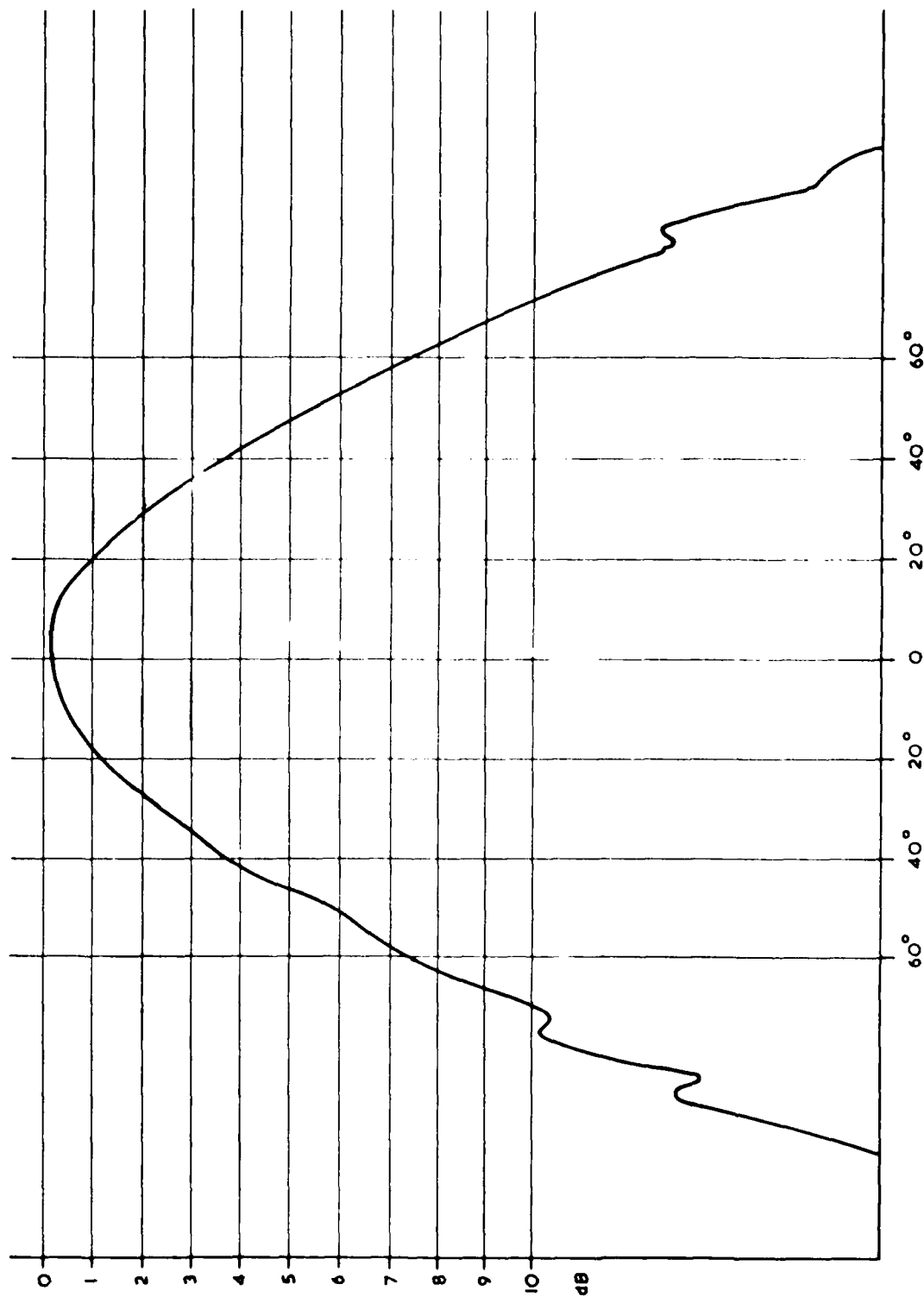


Fig 5.17

Fig 5.17 Elevation array element — azimuth radiation pattern

Fig 5.18

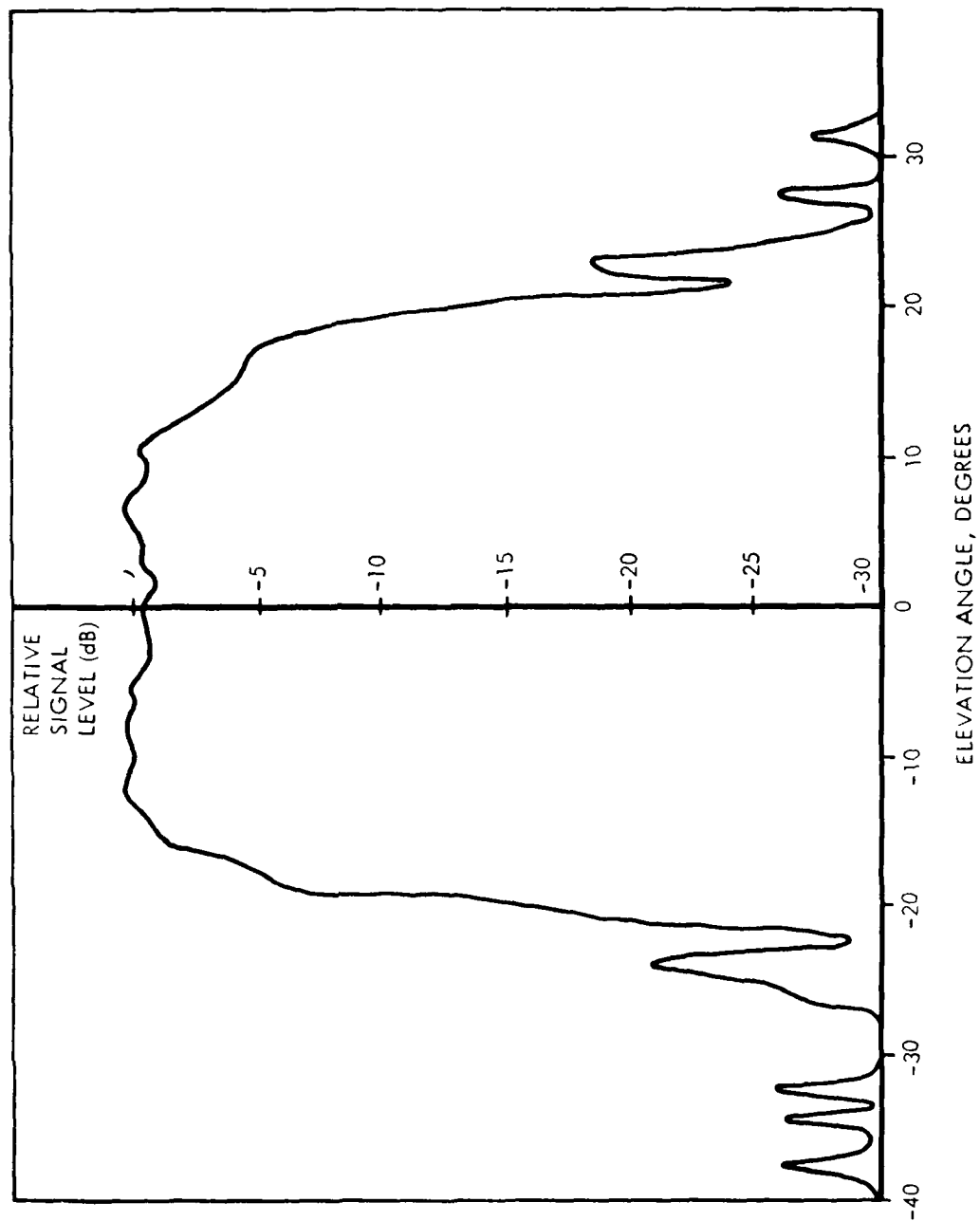


Fig 5.18 Elevation array element — elevation radiation pattern

Fig 5.19



Fig 5.19 Completed 54 wavelength GRP elevation array

Fig 5.20

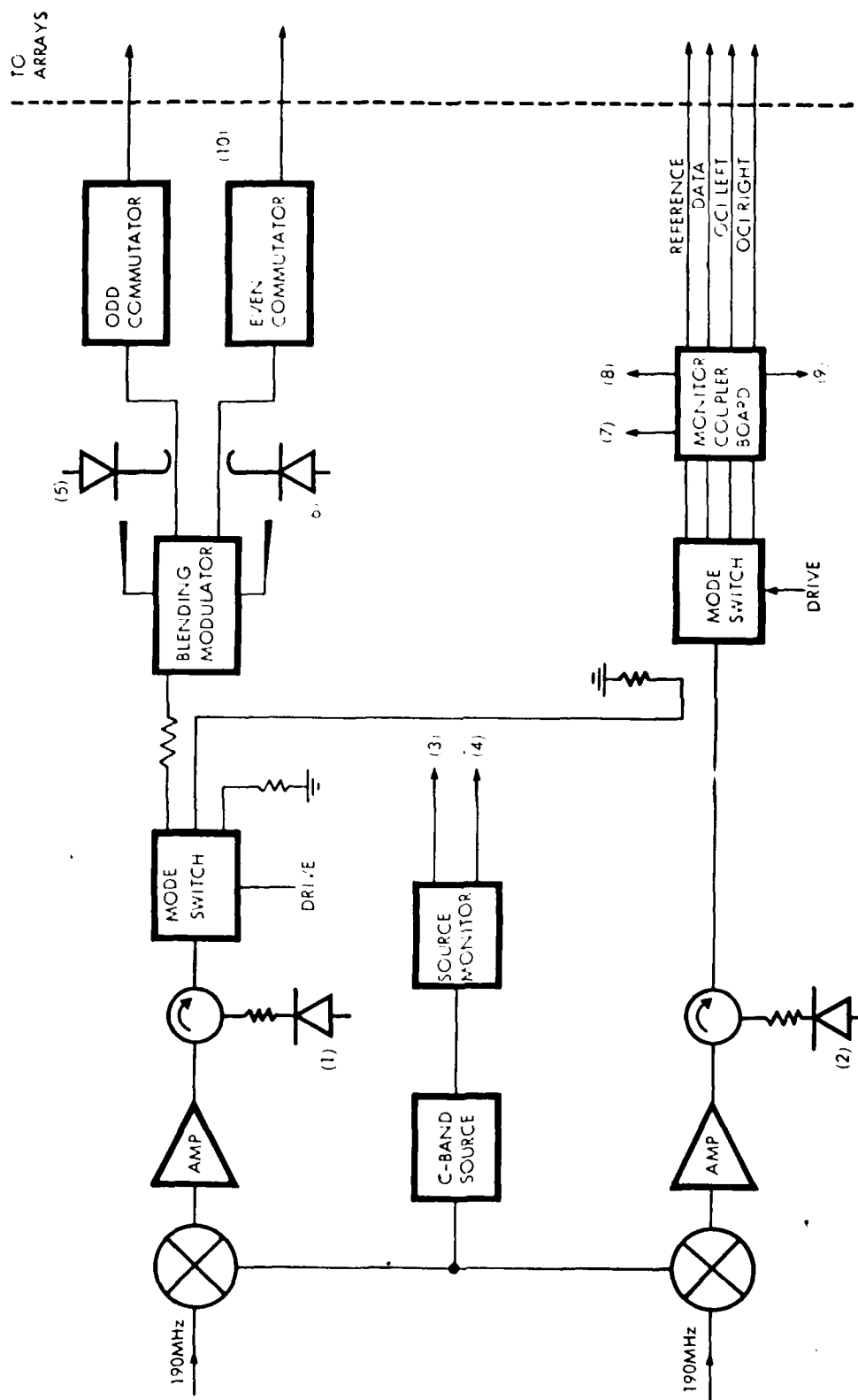


Fig 5.20 Internal monitor — azimuth facility

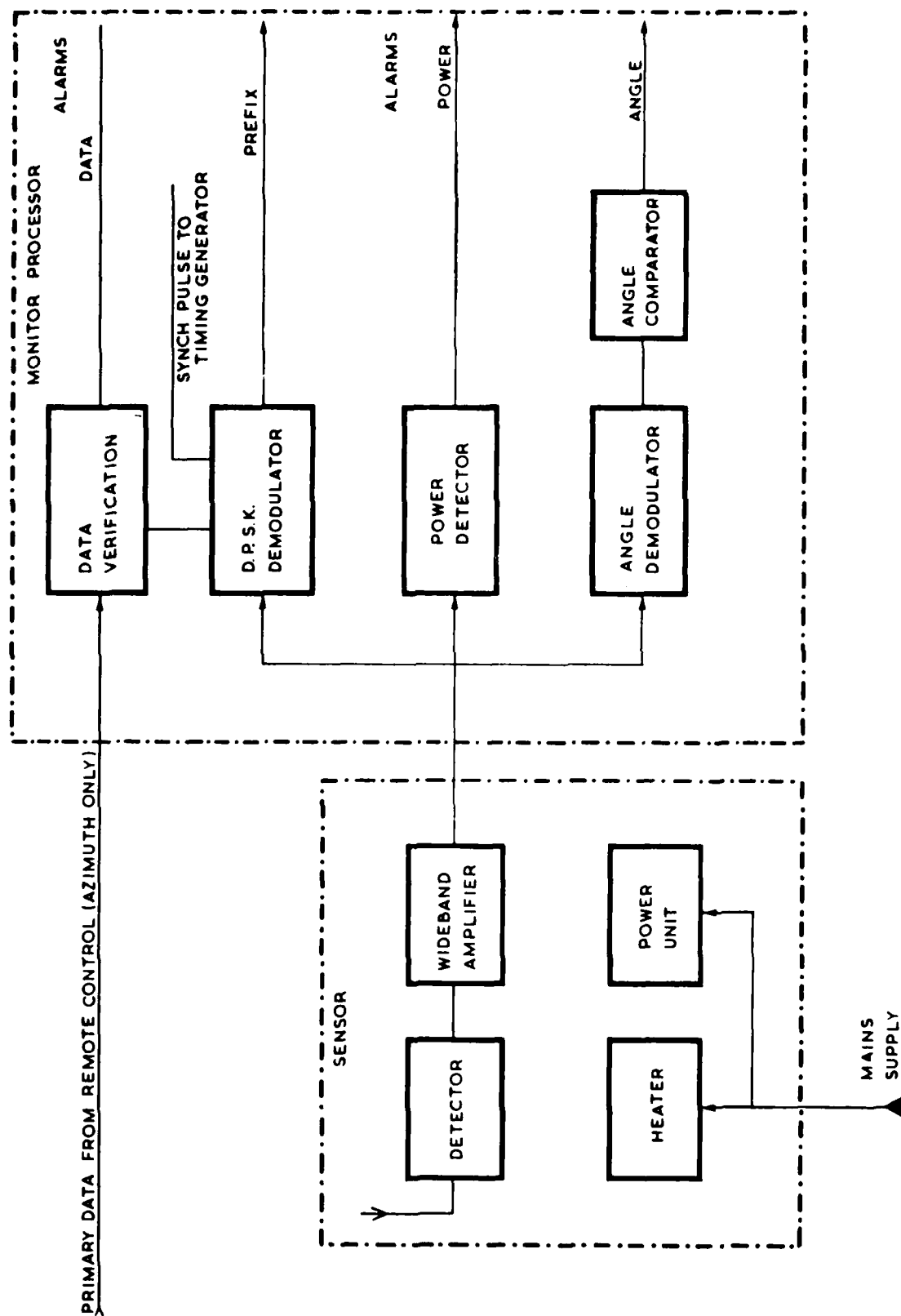


Fig 5.21 Integral monitor

Fig 5.22

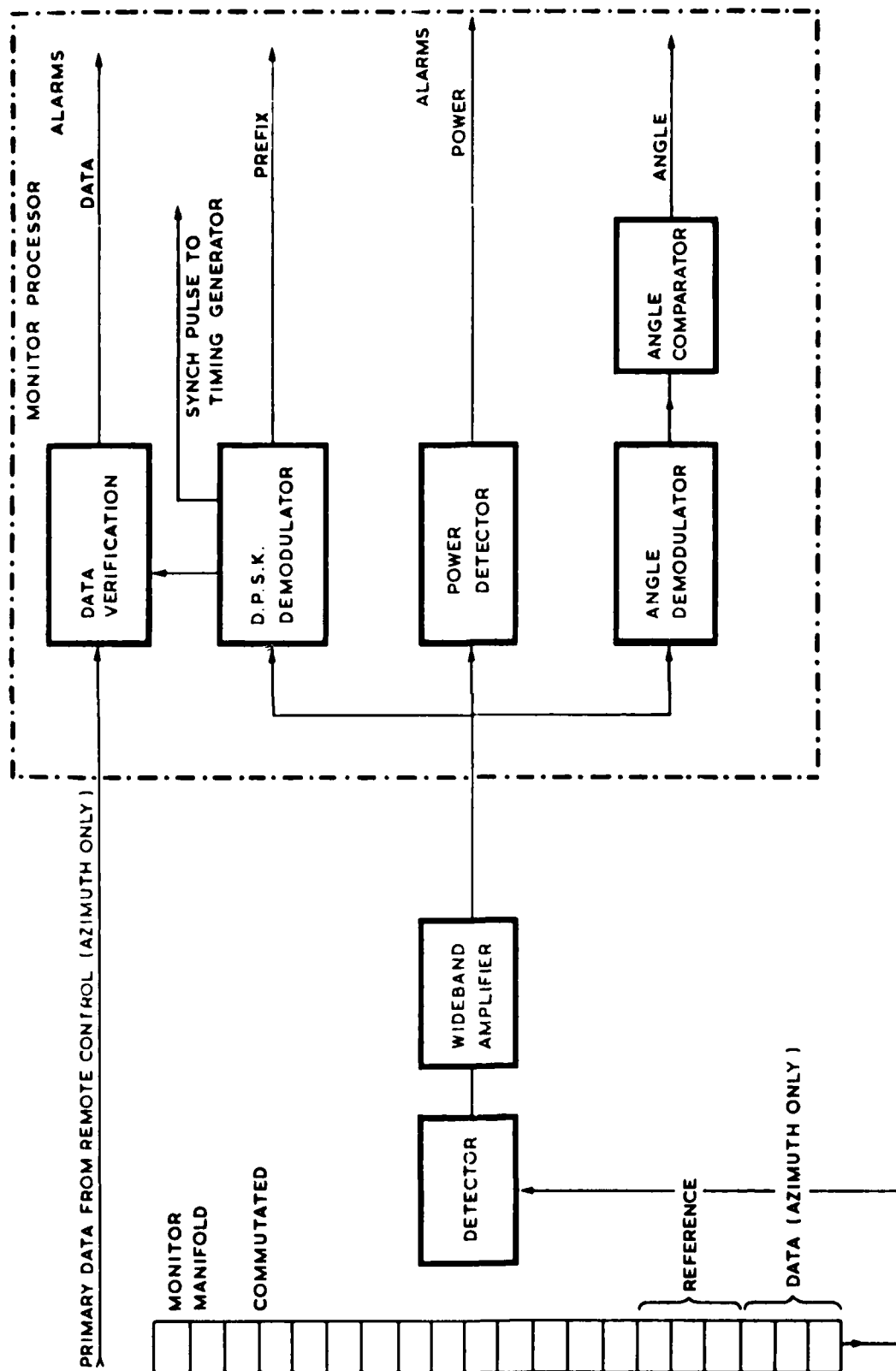


Fig 5.22 Field monitor

Fig 5.23a&b

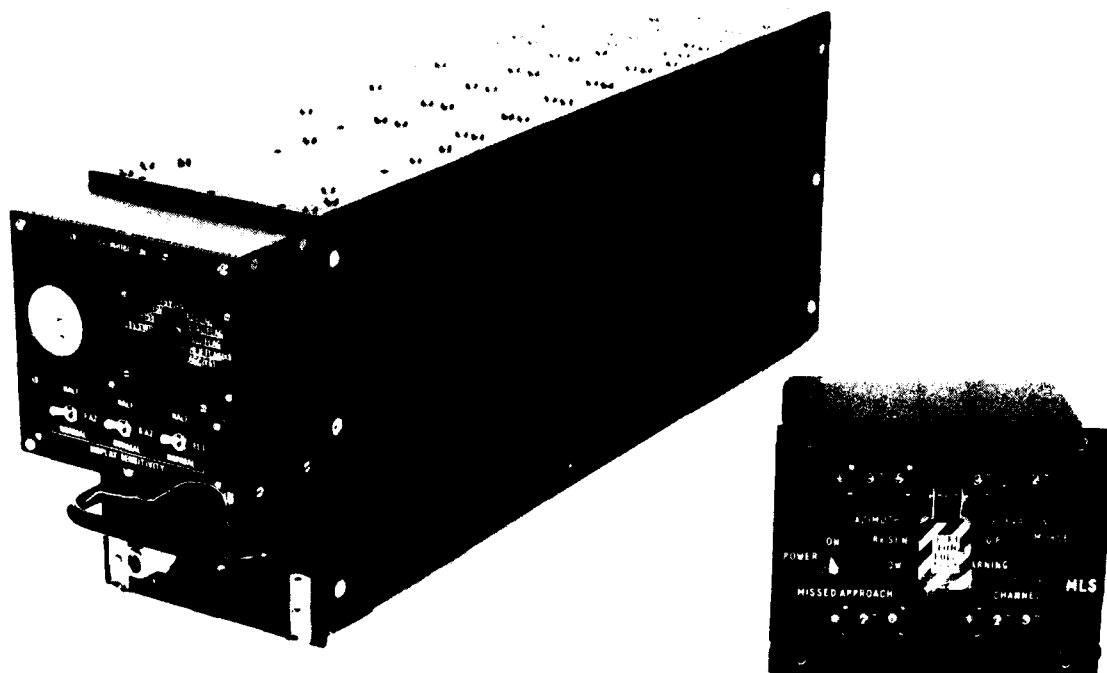


Fig 5.23a Full capability receiver and control unit

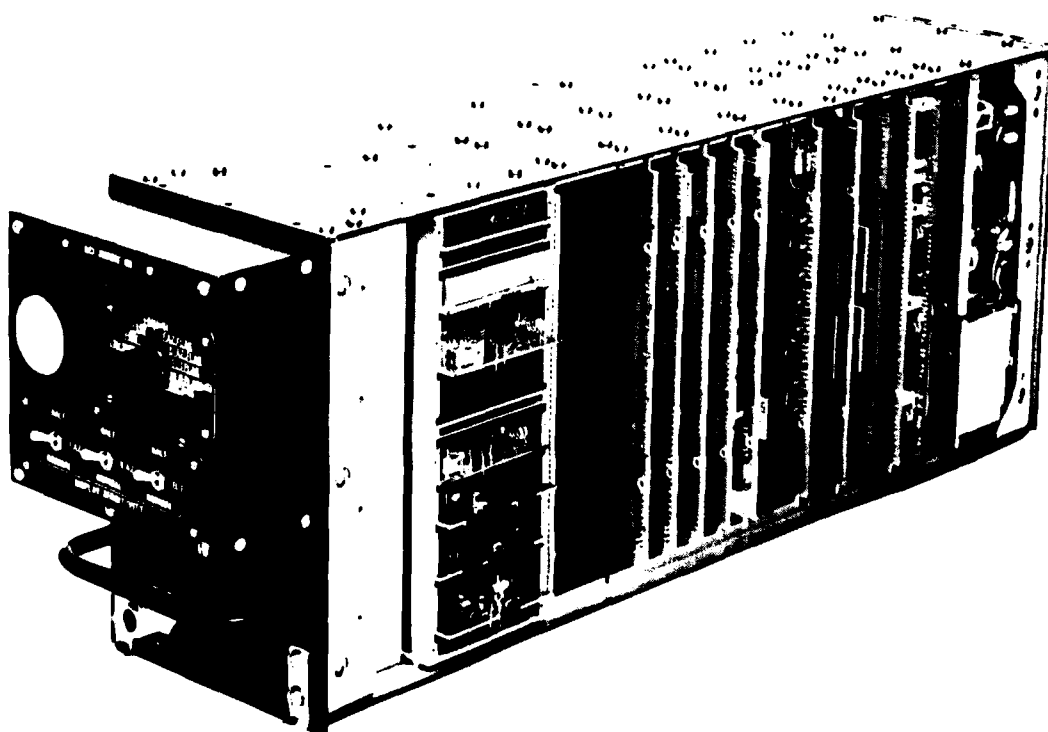


Fig 5.23b Internal view of receiver

Fig 5.24

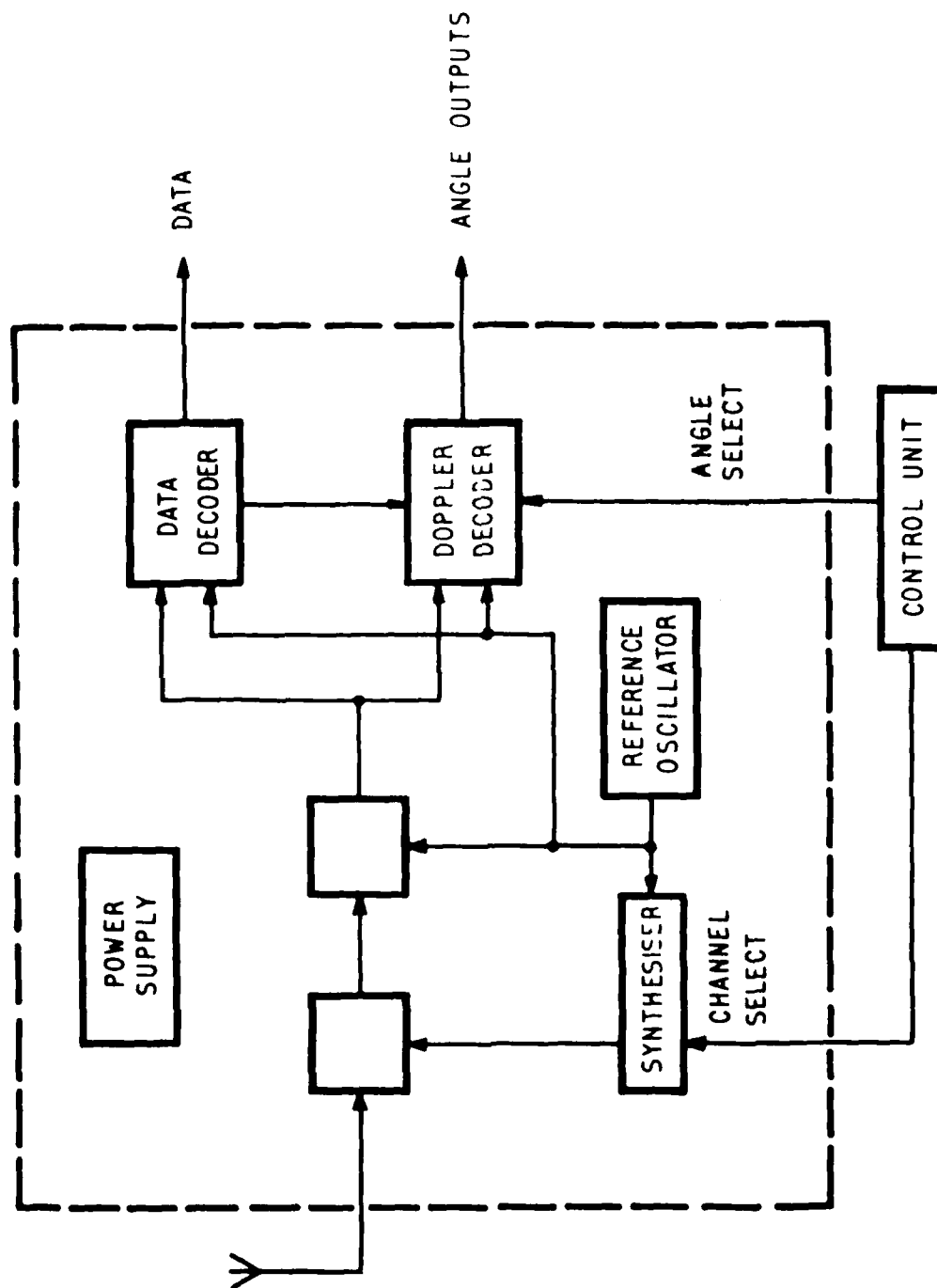


Fig 5.24 Block diagram for TDM receivers

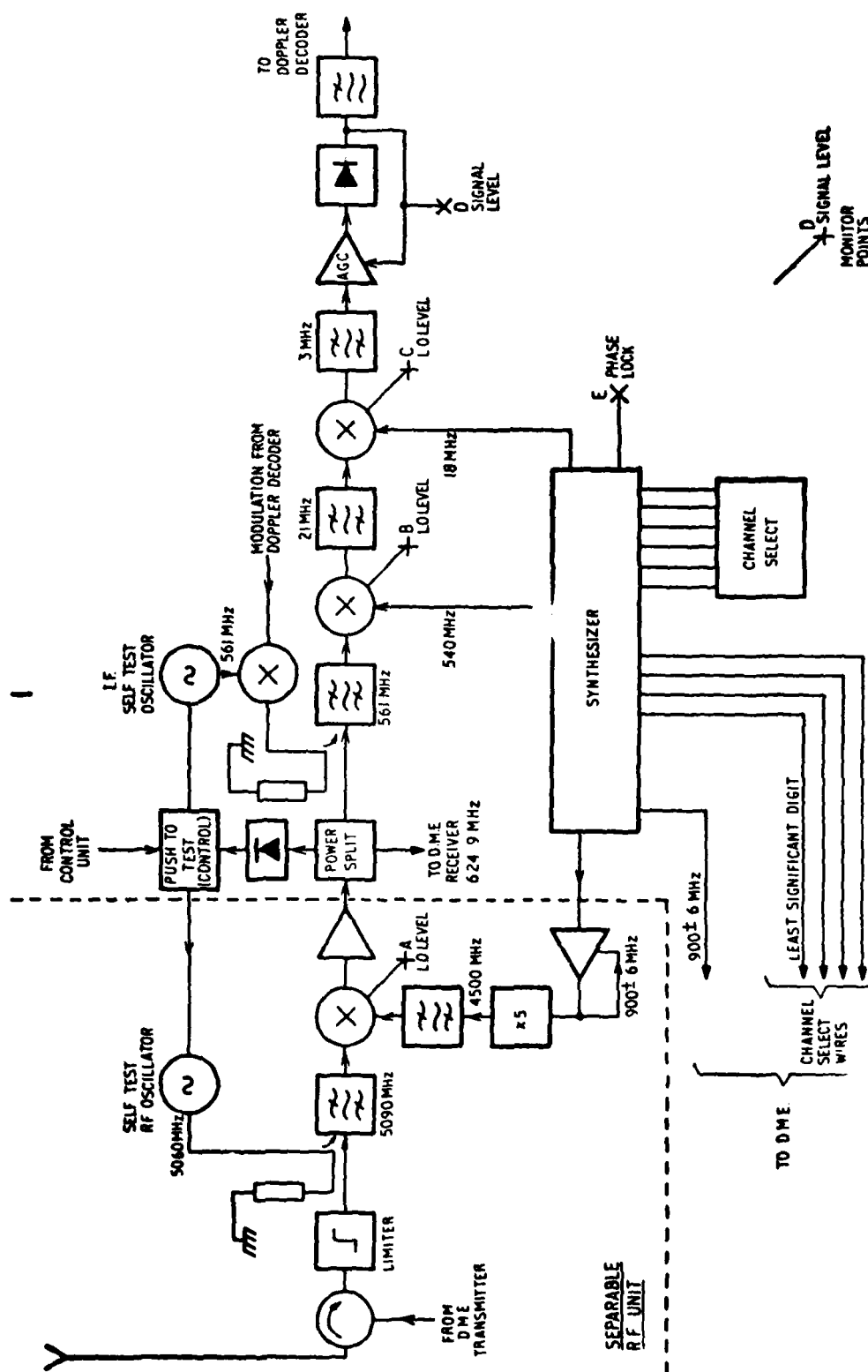


Fig 5.25 Receiver RF/IF circuits

The diagram illustrates the internal architecture of the Channel Code Unit (CCU). It begins with a **VIDEO** input (4.5 kHz) which is processed by a **PRECISION RECTIFIER** and a **3 kHz BW 832 kHz** filter. The resulting **CARRIER** signal is then fed into a **COMPARATOR** and a **ZERO CROSSING DETECTOR**. The **COMPARATOR** also receives a **0V** reference and its output is connected to the **LOCKOUT TIMER & BS RESET** block. The **ZERO CROSSING DETECTOR** outputs a **66.56 kHz** signal to the **LOCKOUT TIMER & BS RESET** block and a **BS** signal to the **32 BIT SR** (Shift Register). The **LOCKOUT TIMER & BS RESET** block also receives an **AGC** (Automatic Gain Control) input and outputs an **ACP** (Automatic Control Pulse) signal. The **32 BIT SR** is clocked by the **66.56 kHz** signal and its output is connected to the **ENV DET & THRESHOLD** block. The **ENV DET & THRESHOLD** block outputs an **ENVELOPE AMPLITUDE** signal to the **OCI COMPARATOR**. The **OCI COMPARATOR** also receives an **AZ OCI** input and outputs an **OCI** signal. The **OCI** signal is then fed into the **75 BIT TIMING REGISTER**. The **75 BIT TIMING REGISTER** outputs **START ANGLE COUNT**, **ANGLE COUNT PERIOD**, **WORD 7 TEST DATA**, **STROBE**, **MB**, **WORD 7 STROBE**, and **STROBE** signals. The **ANGLE COUNT PERIOD** signal is connected to **TP1** and **TP2**. The **WORD 7 TEST DATA** signal is connected to **BD 4**. The **STROBE** signal is connected to **BD 7**. The **MB** signal is connected to **BD 5**. The **WORD 7 STROBE** signal is connected to **BD 6**. The **STROBE** signal is connected to **BD 2**. The **75 BIT TIMING REGISTER** also outputs a **SCAN START** signal to the **SCAN START GEN** block. The **SCAN START GEN** block outputs a **MORSE** signal to the **MORSE GEN** block. The **MORSE GEN** block outputs a **MORSE OUTPUT** signal. The **75 BIT TIMING REGISTER** also outputs a **DATA BUS TO INTERFACE** signal to the **DATA BUS TO INTERFACE** block. The **DATA BUS TO INTERFACE** block outputs a **TEST CHANNEL FLAG** signal. The **75 BIT TIMING REGISTER** also outputs a **TEST CHANNEL VALIDATION** signal to the **TEST CHANNEL VALIDATION** block. The **TEST CHANNEL VALIDATION** block outputs a **TEST CHANNEL COMPARE** signal to the **TEST CHANNEL COMPARE** block. The **TEST CHANNEL COMPARE** block outputs a **GR7 STATUS** signal. The **75 BIT TIMING REGISTER** also outputs a **WORD 7 STORAGE & VALIDATION** signal to the **WORD 7 STORAGE & VALIDATION** block. The **WORD 7 STORAGE & VALIDATION** block outputs a **DATA STATUS** signal. The **75 BIT TIMING REGISTER** also outputs a **INHIBIT UPDATE** signal to the **INHIBIT UPDATE** block. The **INHIBIT UPDATE** block outputs a **PARITY CHECK** signal to the **PARITY CHECK** block. The **PARITY CHECK** block outputs a **PARITY STATUS** signal. The **75 BIT TIMING REGISTER** also outputs a **32 BIT DATA SR** signal to the **32 BIT DATA SR** block. The **32 BIT DATA SR** block outputs a **CLOCK** signal to the **JOHNSON** block. The **JOHNSON** block outputs a **RESET** signal to the **32 BIT SR** and a **CLOCK 2**, **CLOCK 3**, and **CLOCK 4** signal to the **32 BIT DATA SR**. The **32 BIT DATA SR** block outputs a **DATA** signal to the **DO** and **C** blocks. The **DO** and **C** blocks output a **CHANNEL CODE FROM CONTROL UNIT** signal. The **CHANNEL CODE FROM CONTROL UNIT** signal is connected to **BD 2**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 6**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 5**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 4**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 7**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 1**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 3**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 8**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 9**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 10**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 11**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 12**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 13**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 14**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 15**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 16**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 17**. The **CHANNEL CODE FROM CONTROL UNIT** signal is also connected to **BD 18**. 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Fig 5.27

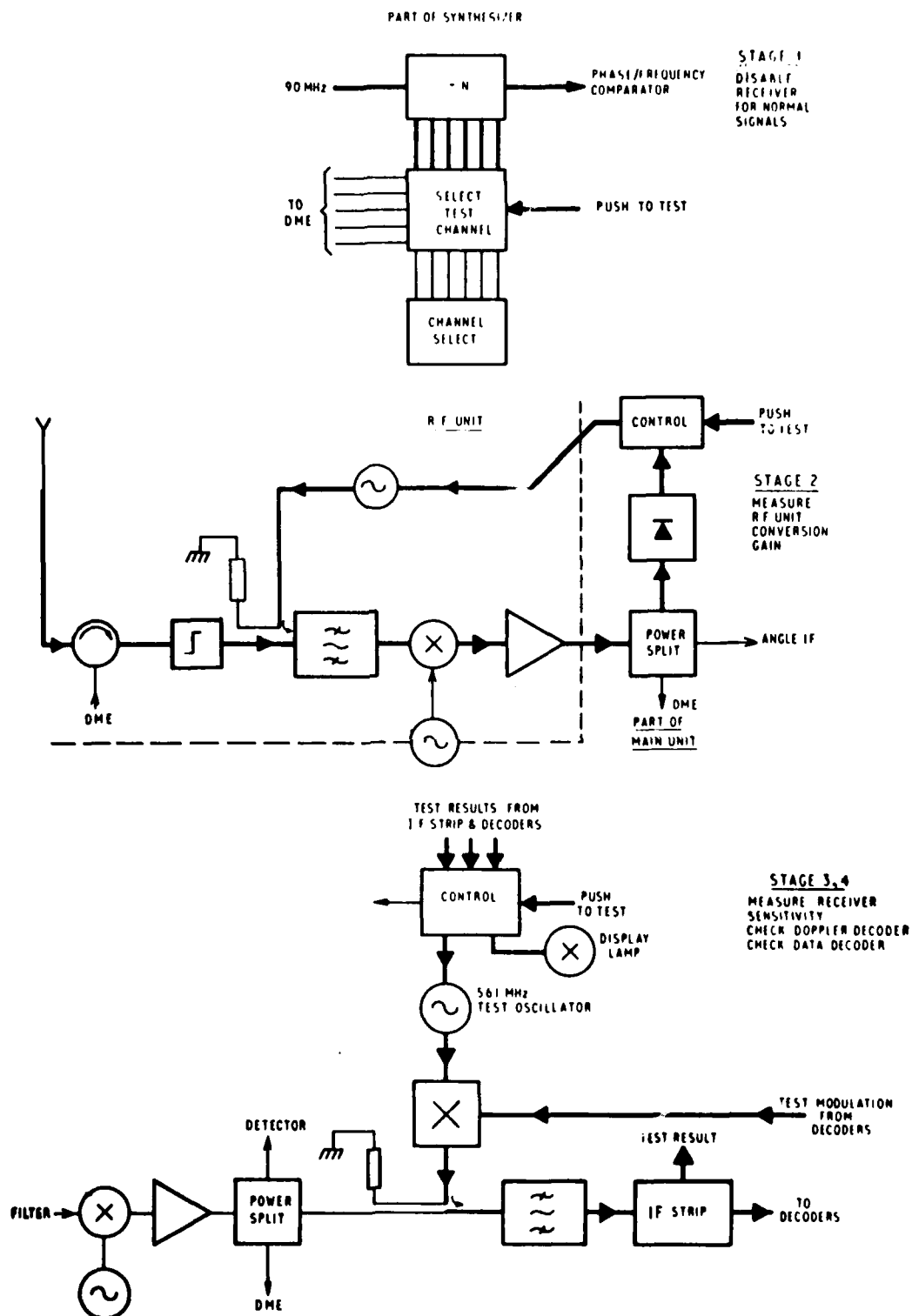


Fig 5.27 RF/IF self test circuit

Fig 5.28

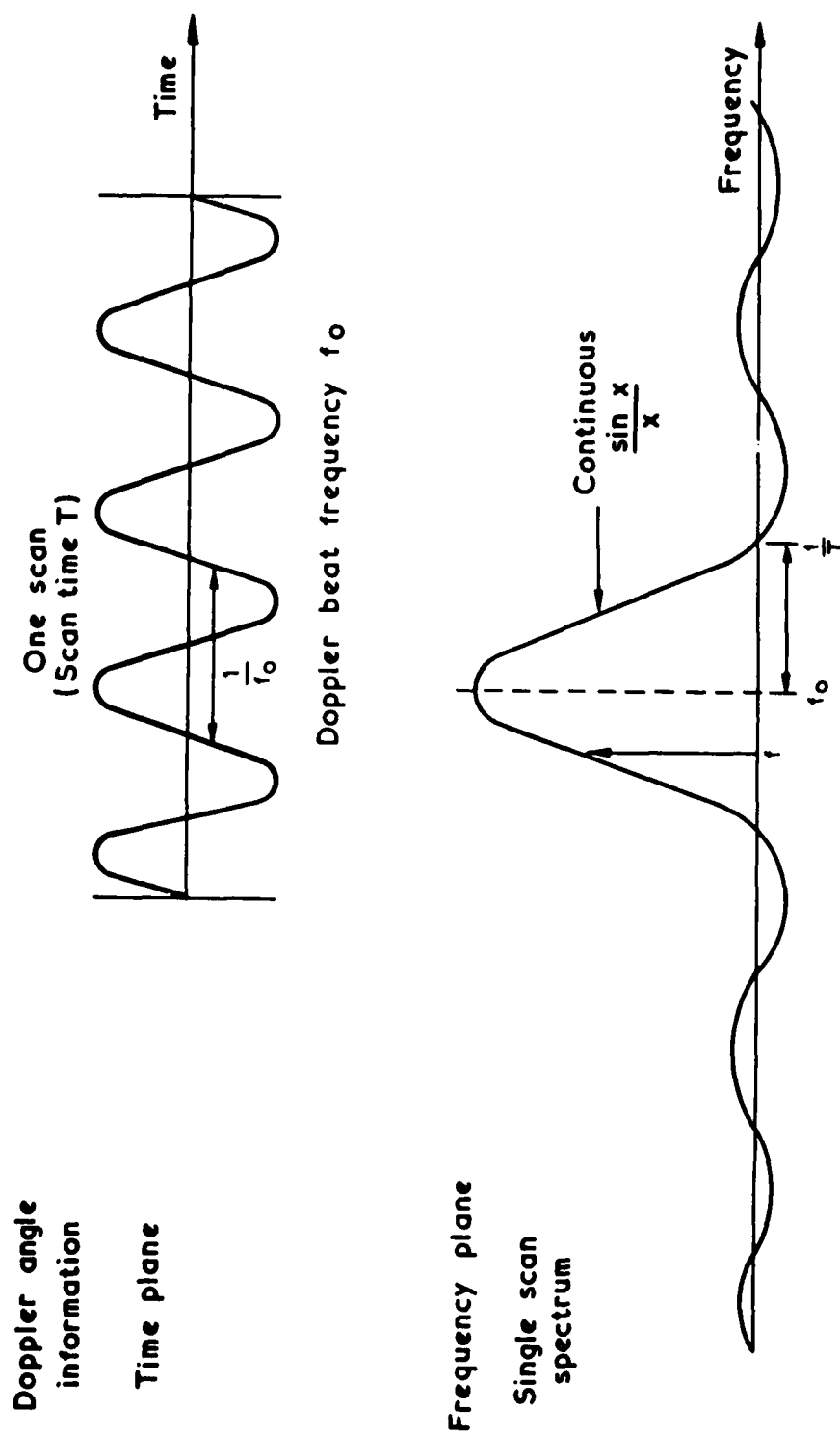


Fig 5.28 The Doppler signal

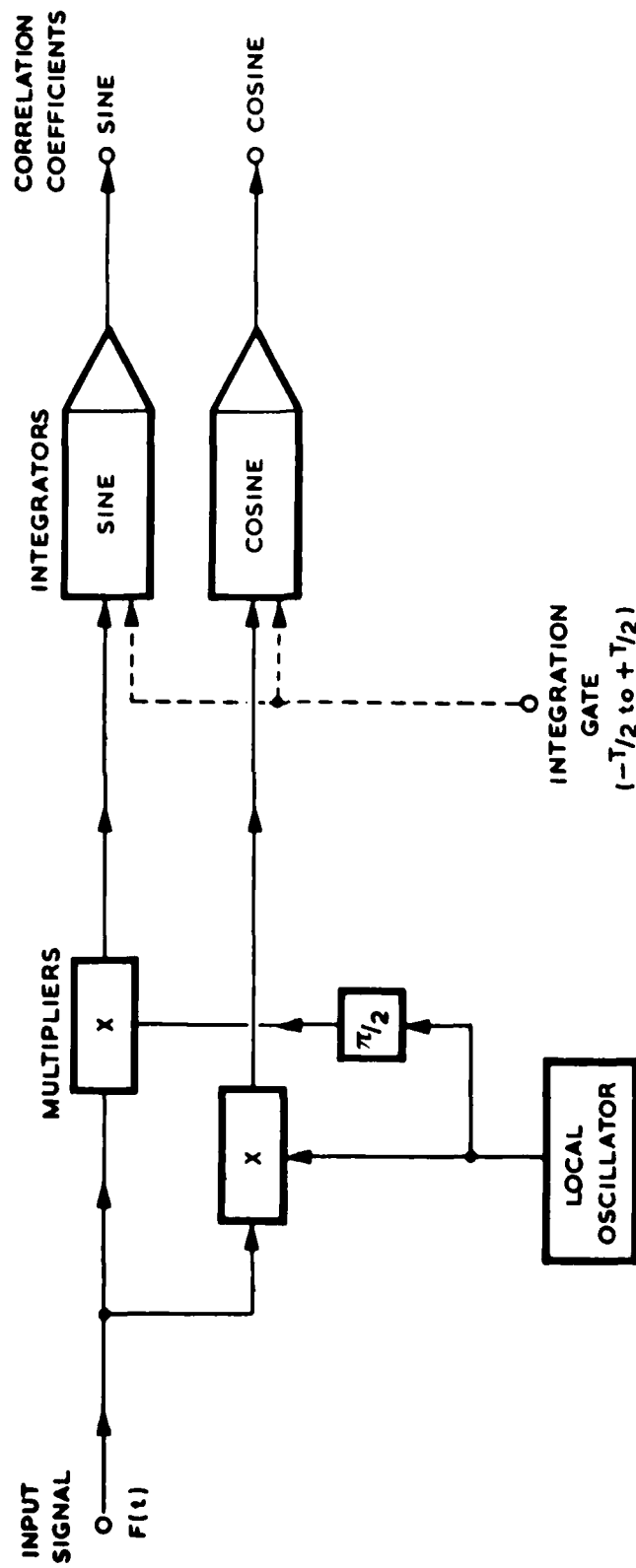


Fig 5.29 Single frequency analogue correlator

Fig 5.30

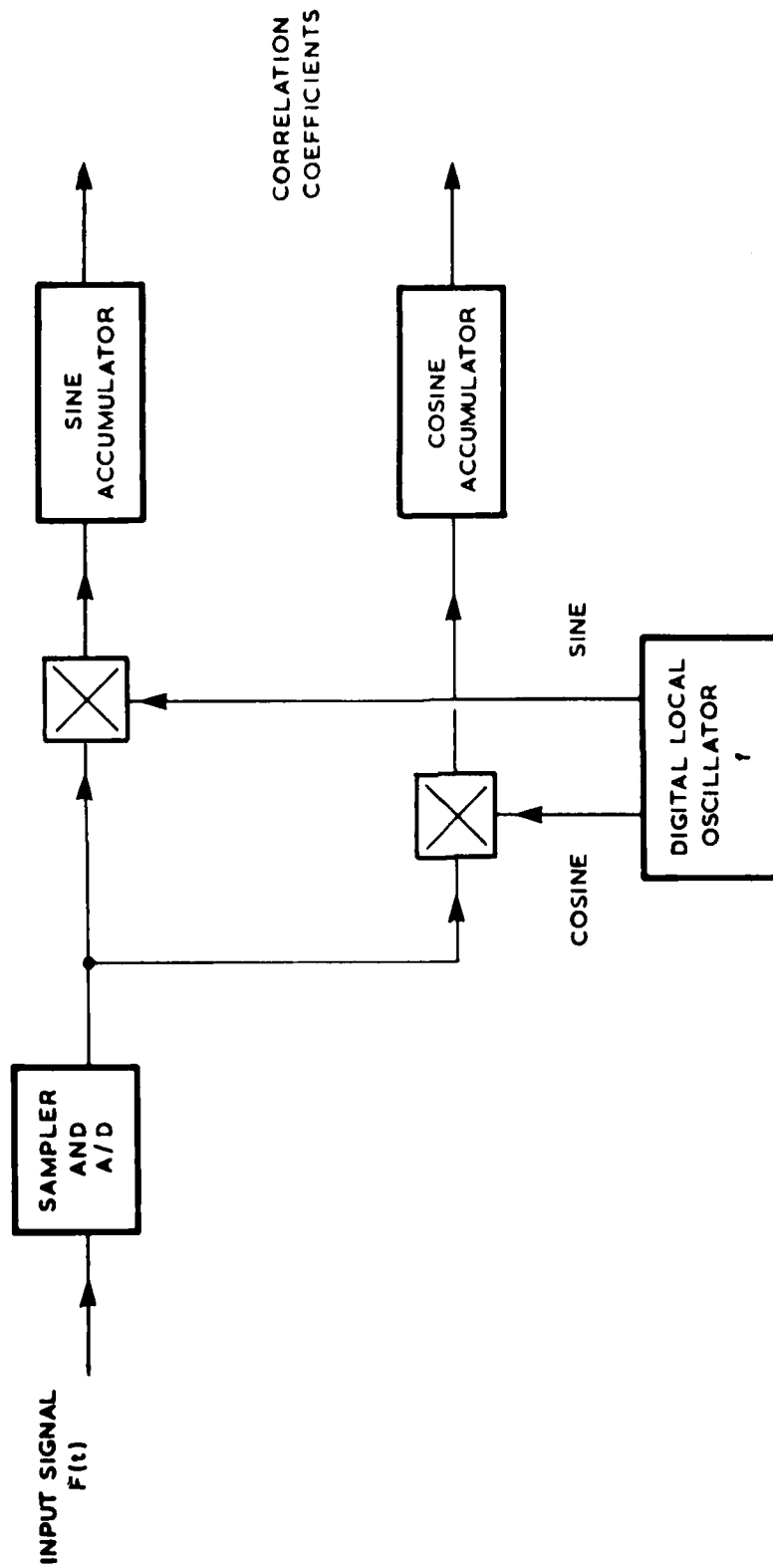


Fig 5.30 Digital frequency correlator

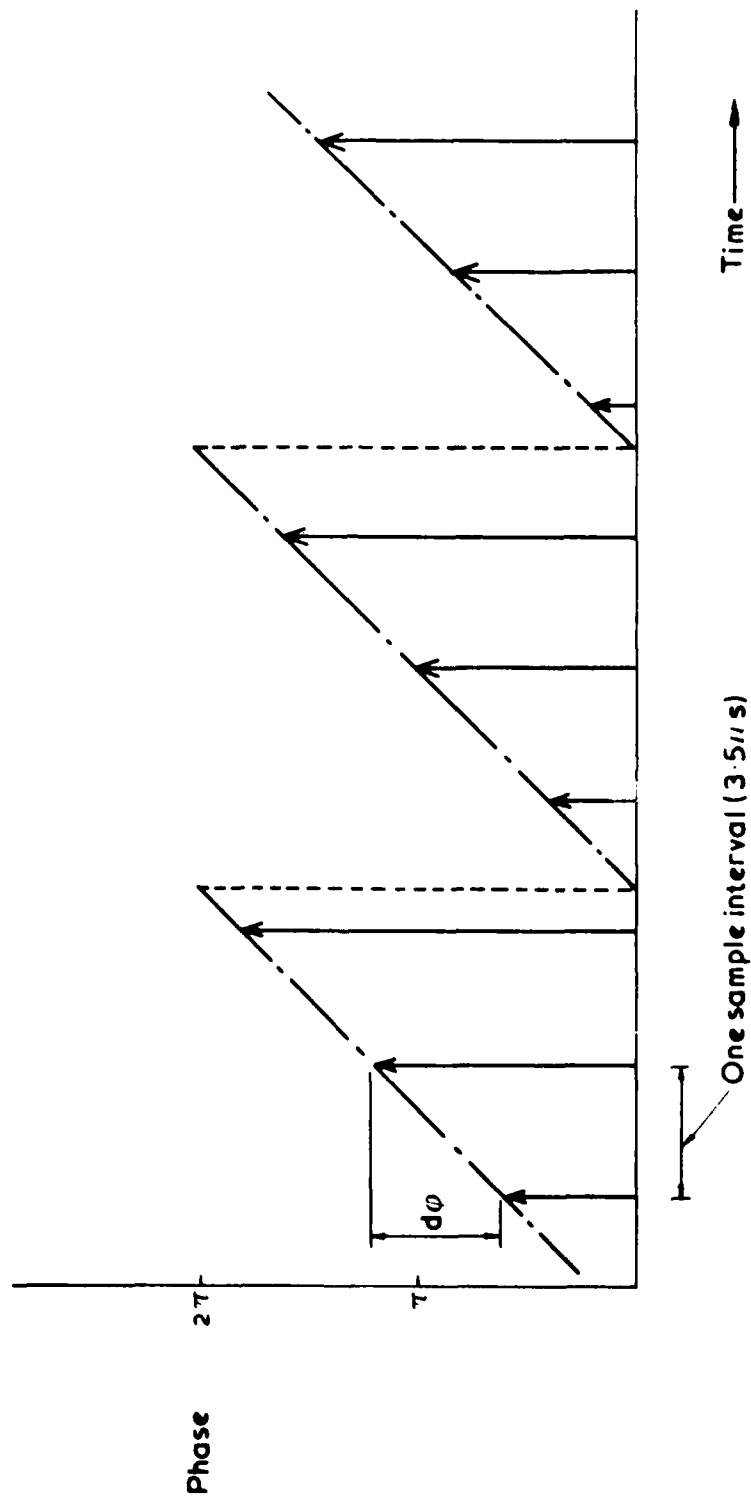


Fig 5.31

Fig 5.31 Digital frequency generation

Fig 5.32

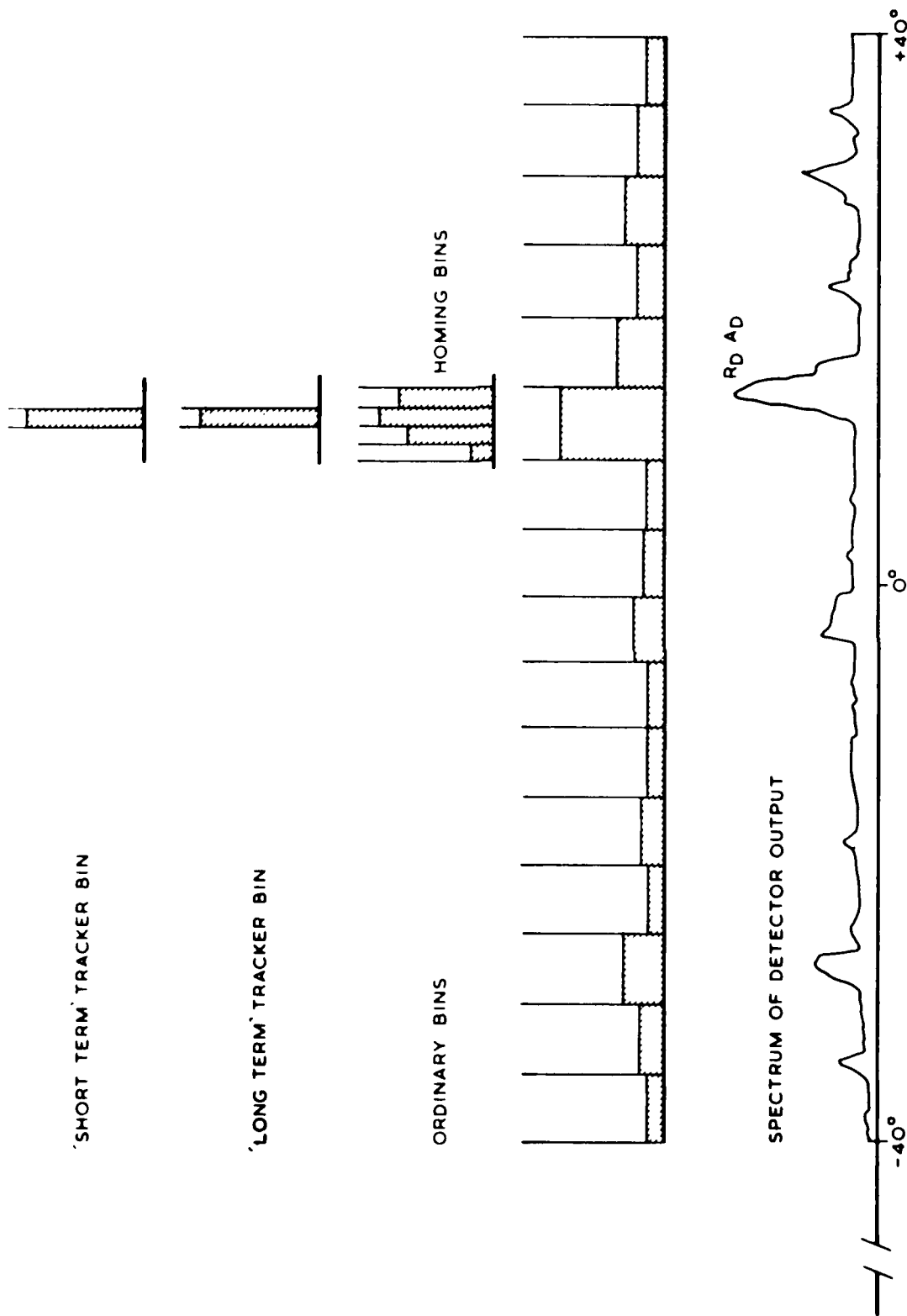


Fig 5.32 Correlator acquisition and validation process

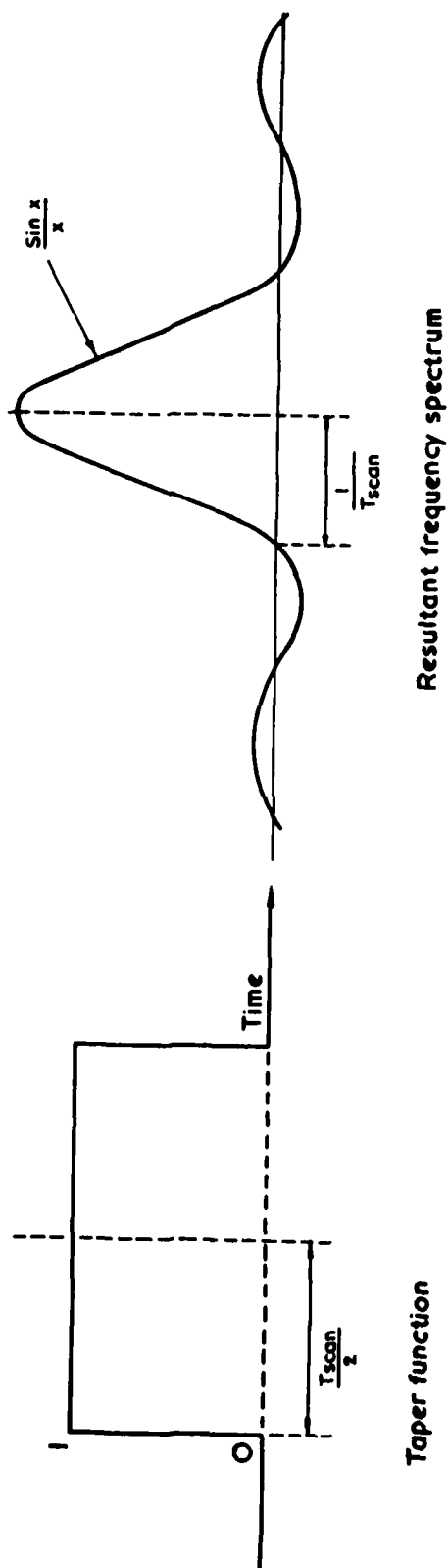


Fig 5.33 The frequency spectrum resulting from the use of a sum taper function

Fig 5.34

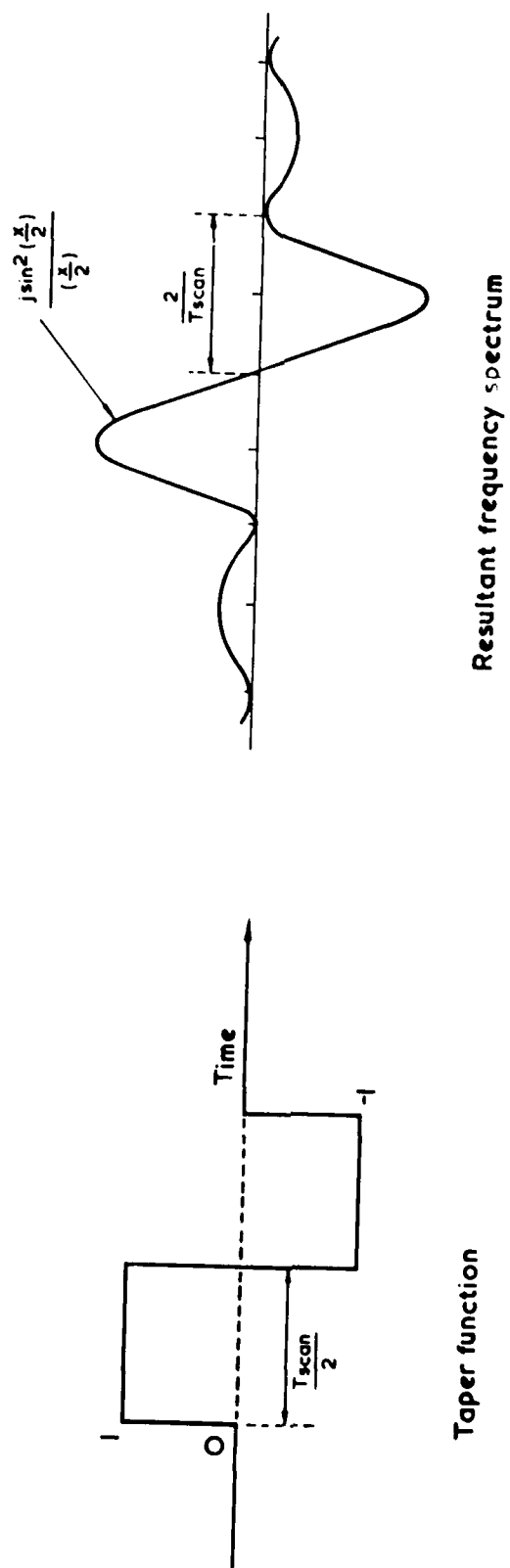


Fig 5.34 The frequency spectrum resulting from the use of a taper function difference

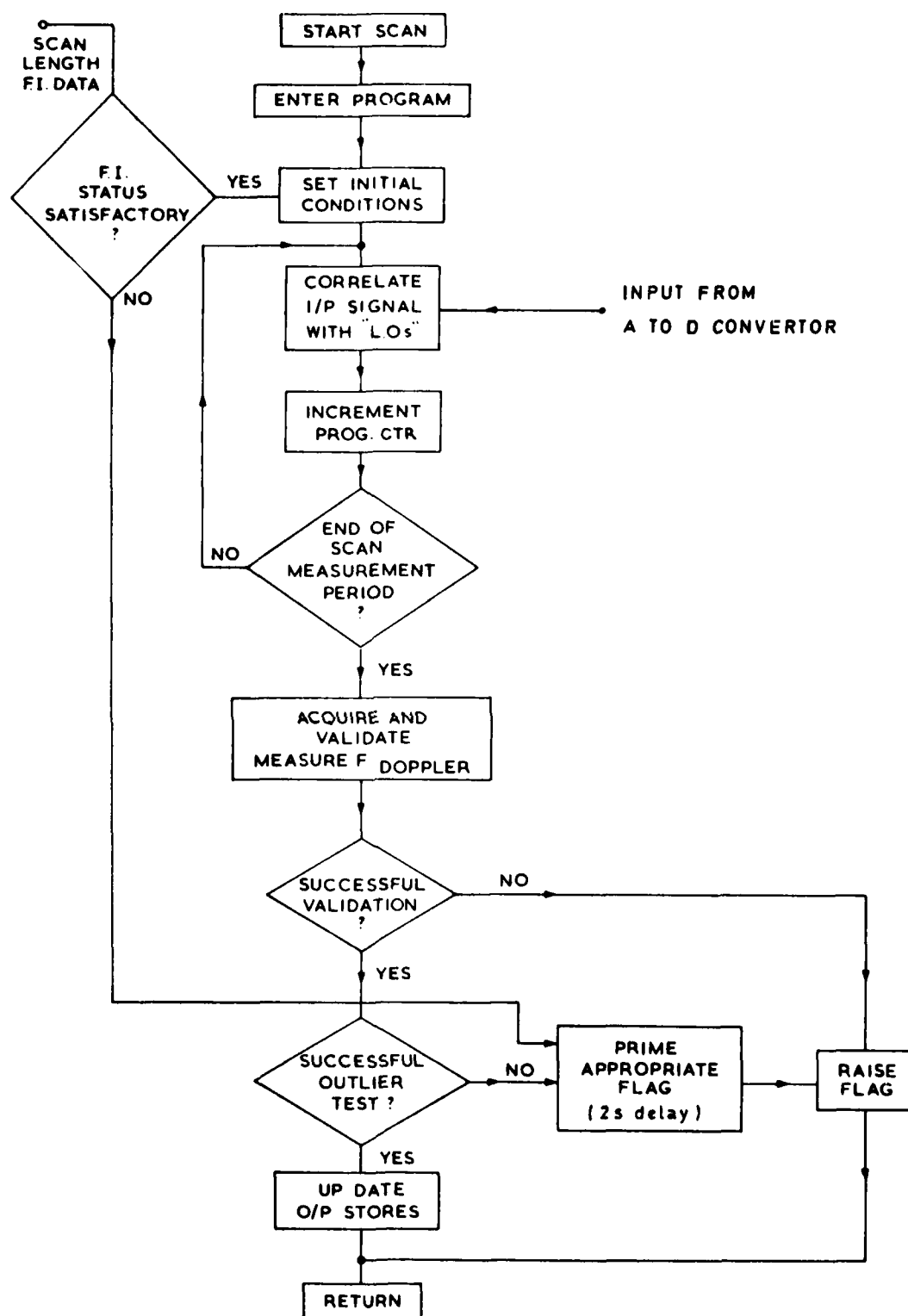


Fig 5.35 Simple correlation system flow diagram

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